WATER WORKS & SEWERAGE

ABP ABC

NEW YORK CITY'S "SLUDGE NAVY" IN PORT

Lithographed on stone by Edward A. Wilson

The arteries of a community are its underground conduits — pipe lines transporting water, gas, sewage, power. Of primary importance are water mains for without water humanity could not exist for a week. It is significant that more than 98 per cent of the water distribution mains of America's 15 largest cities are cast iron mains. It means that, for generations, the best engineering minds have continued to specify cast iron pipe for underground mains.

U. S. PIPE & FOUNDRY CO. • **General Offices: Burlington, N. J.**

Plants and Sales Offices throughout the U. S. A.

U.S.
cast iron
PIPE

● This "3C" Dead Front Sewage Pumping Panel is installed in an Eastern Sewage Disposal Plant.

Eleven motor starters, each equipped with a Disconnect Circuit Breaker and Thermal Overload Relay are housed in the neat cabinet. Suitable START-STOP Push Button with an indicating light showing which motors are operating are mounted in the Dead Front.

Doors which close flush with the surface of the panel provide easy access to all control apparatus.

The following motors are protected by "3C" Bulletin 6013 Starters.

3—10 H. P. Sewage Pump Motors
2—1½ H. P. Comminutor Motors
2—½ H. P. Clarifier Motors
1—½ H. P. Organic Return Motor
1—2 H. P. Cleaning Mechanism Motor
1—1 H. P. Collecting Motor
1—⅓ H. P. Blower Motor

Two additional Circuit Breakers are provided for future loads, and an 8 circuit flush type lighting panel and also a Recording Time and Pressure Instrument for three Sewage Pumps.

Similar panels, "3C" designed and built, are rendering splendid service in water works and sewage treatment plants all over America. Our nearest office will gladly consult with you.

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

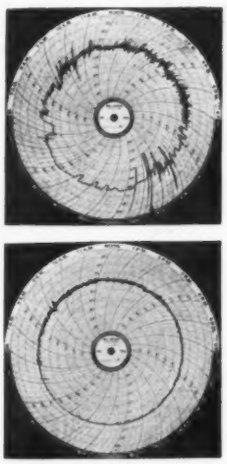
1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, September, 1941. Volume 88. Number 9. Published monthly at 330 South Wells Street, Chicago, Ill. Per copy, 25c. Subscription rate, United States $2.00 per year; Canada $2.40 per year; Foreign $3.00 per year. Copyright, 1941, by Gillette Publishing Co. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

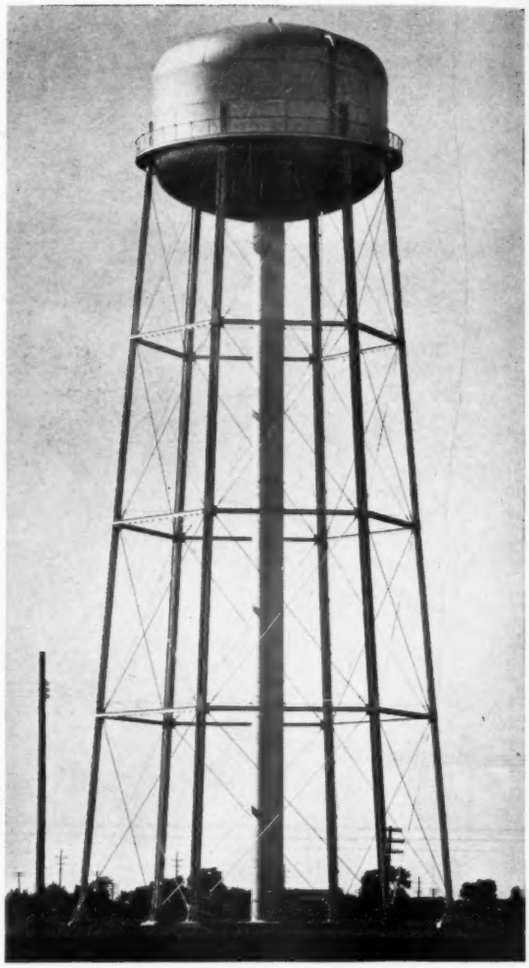
2 New ELEVATED TANKS

INCREASE FIRE PROTECTION at Kankakee, Illinois

RIGHT: Top chart shows pressure in Kankakee water mains BEFORE elevated tanks were in service. Lower chart shows pressures at same location AFTER tanks were installed.



LEFT: 750,000-gal. radial-cone tank. RIGHT: 200,000-gal. ellipsoidal-bottom unit.



A study of the water supply system at Kankakee, Ill., made by the National Board of Fire Underwriters, revealed the fact that existing filters and storage facilities limited the capacity of the system to slightly below maximum consumption and fire flow demands. Following recommendations of this organization, the Kankakee Water Company installed two new elevated storage tanks in its distribution system. One is a 750,000-gal. radial-cone bottom unit located in the business center, and the other a 200,000-gal. tank with ellipsoidal roof and bottom, installed in a northern subdivision.

In addition to providing increased fire protection, these two new Horton tanks have helped to eliminate pressure variations in the distribution system, as shown in the above charts. This is another example of the way in which modern elevated storage solves municipal water supply problems.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 McCormick Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Builder's Exchange	Houston	5615 Clinton Drive	San Francisco	1083 Rialto Bldg.
Havana	402 Edificio Abreu	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Plants at BIRMINGHAM, CHICAGO, and GREENVILLE, PA. *In Canada:* HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.

CLOW-NATIONAL

Super-deLavaud Cast Iron Pipe

Yarning the Joint

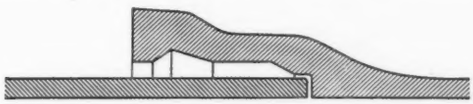
Pouring the Joint

Calking the Joint

CLOW-NATIONAL Super-deLavaud cast iron pipe is centrifugally cast in water-cooled steel molds WITHOUT CHILL. It is a superior pipe with a dense close-grained metal structure free from blow-holes, sand or slag inclusions. The pipe wall is of uniform thickness from end to end, and inside and outside diameters are true circles—absolutely concentric. Super-deLavaud pipe is a tough pipe with unusually high tensile strength combined with great ductility. It is highly resistant to shock, and its physical properties meet the requirements of Federal Specifications WW-P-421 for Type "I" cast iron water pipe.

The deLavaud pipe casting machines, in which Clow-National pipe in sizes through 24-inch are made, exercise positive control over the outside diameter of the pipe, while the pipe wall thickness and inside diameter can be readily varied to meet any specification. Super-deLavaud cast iron pipe can be cut easily with sledge and chisel, and drilling and tapping it for branch lines results in superior threads and perfect connections.

Available with ten individual types of joint, Super-deLavaud cast iron pipe can be furnished to meet the specific needs of any pipe line job.



Standard Water Bell

A self-centering shoulder in base of bell eliminates wedging and keeps each pipe in good alignment with all others in the line. This means faster and better calking, a saving of joint materials, and a better joint.

Super-deLavaud cast iron pipe with *standard water bells* is available in sizes from 3 to 24 inches inclusive, for all pressures, and in both 12 and 18-foot lengths. Price and delivery schedule upon request.

PIPE ECONOMY

Just off the press. A three hundred twelve page complete and practical reference book for engineers, buyers and users of cast iron pipe. Have you received your copy?

CLOW-NATIONAL

JAMES B. CLOW & SONS
201-299 N. Talman Avenue
CHICAGO, ILL.

SALES OFFICES
In All Principal Cities

NATIONAL CAST IRON PIPE
(A Division of James B. Clow & Sons)
BIRMINGHAM, ALA.

LINK-BELT Equipment

FOR POSITIVE RESULTS — LOW COST OPERATION

STRAIGHTLINE COLLECTORS

Link-Belt STRAIGHTLINE Sludge Collectors for the removal of sludge from rectangular settling tanks consist of two strands of especially processed malleable chain from which are suspended, at uniform intervals, scraper flights usually made from red wood. Features are peak-cap bearings, swiveling flights, cross collectors for larger tanks, and positive sludge removal at a slow, uniform speed. Automatic or semi-automatic skimming equipment is furnished when required.

Years of uninterrupted service in a great many plants throughout the country have proved the high efficiency, durability and low-cost maintenance features of these units.

Many features of the Link-Belt STRAIGHTLINE Collector are patented. Send for Book No. 1742.

CIRCULINE COLLECTORS

Link-Belt CIRCULINE Collectors for the removal of sludge from round tanks, consist of a flight conveyor suspended from a bridge, one end of which is pivoted at the center and the other travels around the circumference of the tank. Features are positive, slow, uniform speed, positive sludge removal and excellent distribution of flow throughout the tank. Automatic skimming is furnished when desired.

Send for Book No. 1642.

BIO-FILTRATION System For Treating Sewage

Bio-Filtration Sewage Treatment System with Link-Belt STRAIGHTLINE and CIRCULINE Collectors brings new advantages. The system consists of high rate shallow filter beds and recirculation of the effluent from the filter beds to the primary tanks. Features are great flexibility, high rate of B.O.D. loading and the ability of such a plant to handle strong domestic and industrial sewage in single-stage or two-stage treatment, as required. Many installations of this type are now in operation and under construction.

Send for Folder No. 1881.

STRAIGHTLINE Bar Screens

Link-Belt STRAIGHTLINE Mechanically-Cleaned Bar Screens have spaced parallel bars on which the larger floating solids in incoming sewage collect, and a mechanically operated rake for removal of the accumulating solids, thus assuring an even flow of sewage through the channel. The machine may be set vertically or inclined, and used in small or large plants. Send for Folder No. 1587.

TRITOR Screens

The Link-Belt Tritor Screen is a combination of screen and grit chamber. It is especially designed for medium and small size plants. Its main elements are a hopper, a bar screen, and a bucket elevator for removing grit from hopper, the buckets being perforated for drainage. On return run, rake teeth on buckets clean the screen. An adjustable weir regulates velocity of flow through hopper.

Send for Folder No. 1587.

INDUSTRIAL WASTE SCREENS

The Link-Belt Industrial Waste Screen is an efficient and economical unit for the removal of objectionable suspended solids from industrial waste before the water is discharged into sewers or streams. The screenings come off the machine with a minimum of moisture. Units are available in several sizes and with coarse or fine screen medium. Wastes from canneries, textile mills, steel mills, etc., are handled successfully by these screens.

Send for Folder No. 1877.

STRAIGHTLINE Grit Collectors And Washers

The Link-Belt STRAIGHTLINE Grit Collector and Washer effectively collects, washes and removes settled grit and separates it from putrescible organic matter. This unit consists of a scraper type collector with pitched flights which turn the material over and over and discharges it into a washing and dewatering screw at the influent end of the tank, from which it is carried up an incline to a point of discharge.

Send for Folder No. 1942.

Other LINK-BELT WATER and SEWAGE TREATMENT PLANT EQUIPMENT INCLUDES: STRAIGHTLINE Mixers for Flocculation Tanks; STRAIGHTLINE Scum Breakers for Digestion Tanks; Elevated Diffusers; Traveling Water-Intake Screens; Roto-Louvre Dryers for sludge and other wet materials; P.I.V. Gear Variable Speed Drive for Pumps; Coal and Ashes Handling Machinery; Car Spotters and Haulage Systems; Shovels-Cranes-Draglines—Crawler, Tractor and Truck Mounted; and a complete line of elevating, conveying and power transmitting equipment. Catalogs sent on request.

THE SYMBOL OF QUALITY — LB — A LINK-BELT

LINK-BELT COMPANY

Specialists in the Manufacture of Equipment for Water and Sewage Treatment Plants

PHILADELPHIA	CHICAGO	LOS ANGELES	CLEVELAND
2045 W. Hunting Park Ave.	300 W. Pershing Road	361 S. Anderson St.	548 Rockefeller Bldg.

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Shovel-Crane-Dragline Division—Link-Belt Speeder Corp., Chicago and Cedar Rapids

8451

The Heart of the Empire STREEEMLINE METER

TIME PROVEN, BALANCED, OSCILLATING PISTON

THERE is but one moving part w[illegible] measuring chamber of the Stree[illegible]e Meter, the famous EMPIRE Balanced Piston. The perfect balance in this piston is attained by the location of the web at the vertical center of the piston. The pressure on both sides of the web is thus equalized resulting in a piston that practically glides between the top and bottom half of the chamber with minimum friction and wear.

On the bottom circumference of the oscillating piston is located a hard rubber roller bearing called the Piston Pilot that operates in a slot cut in the lower half of the measuring chamber on the inlet side. The Piston Pilot, besides acting as a guide to control the movement of the piston, eliminates all contact between the piston and the division plate. Its rolling action prevents friction, thereby providing greater sensitivity, increased accuracy at low flow rates, and assures sustained, quiet operation.

The balanced oscillating piston is only one of the many features of the EMPIRE Streeemline. This meter is the culmination of 71 years of measurement experience. Its construction embodies the indicated preferences of many water works men. It provides the unequalled performance characteristics of the time proven oscillating piston design, plus improvements and refinements resulting from present day knowledge and engineering advances.

All the features of the EMPIRE Streeemline Meter are described in detail in a new Catalog N-307. Write for a copy or arrange to have a Pittsburgh-National representative call.

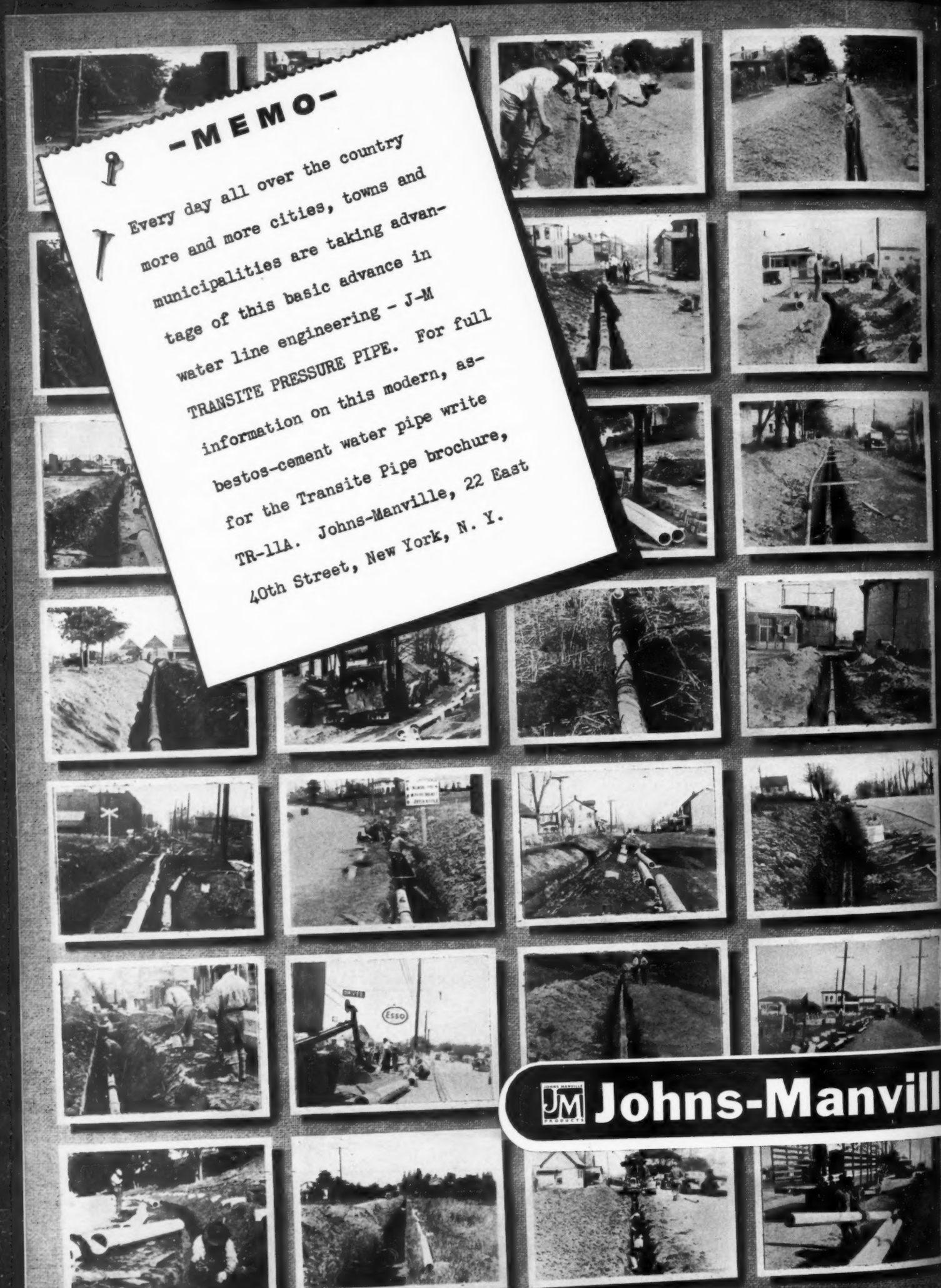
PITTSBURGH EQUITABLE METER COMPANY

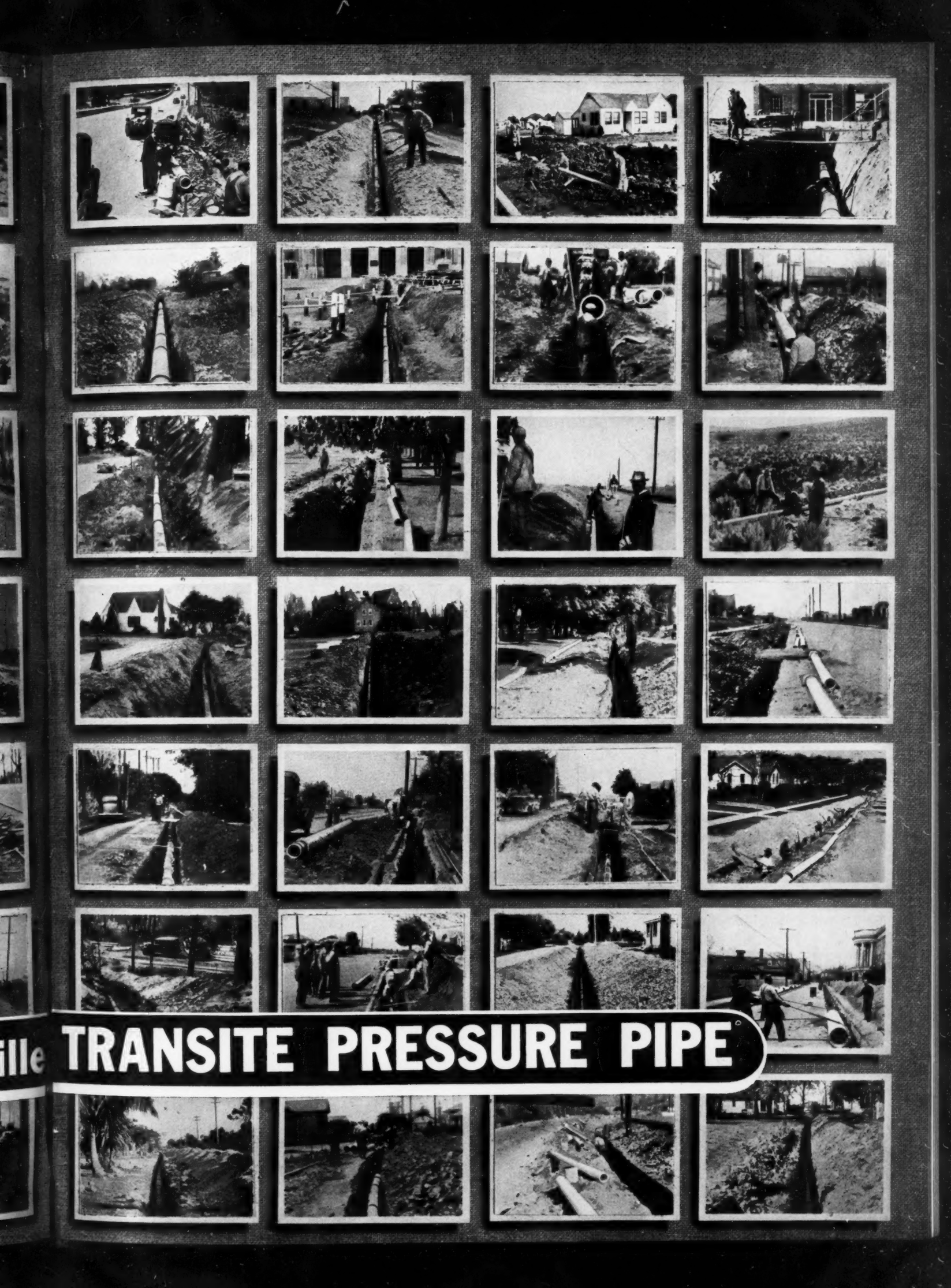
NEW YORK · BROOKLYN · DES MOINES · MEMPHIS · DALLAS · TULSA · CHICAGO · BOSTON

MERCO NORDSTROM VALVE COMPANY
Main Offices, Pittsburgh, Pa.
NATIONAL METER DIVISION, Brooklyn, N. Y.

KANSAS CITY · PHILADELPHIA · SAN FRANCISCO · LOS ANGELES · SEATTLE · HOUSTON · COLUMBIA · BUFFALO

THE MOST COMPLETE LINE OF WATER METERS IN THE WORLD


-MEMO-
Every day all over the country more and more cities, towns and municipalities are taking advantage of this basic advance in water line engineering - J-M TRANSITE PRESSURE PIPE. For full information on this modern, asbestos-cement water pipe write for the Transite Pipe brochure, TR-11A. Johns-Manville, 22 East 40th Street, New York, N. Y.
Johns-Manville


ille
TRANSITE PRESSURE PIPE

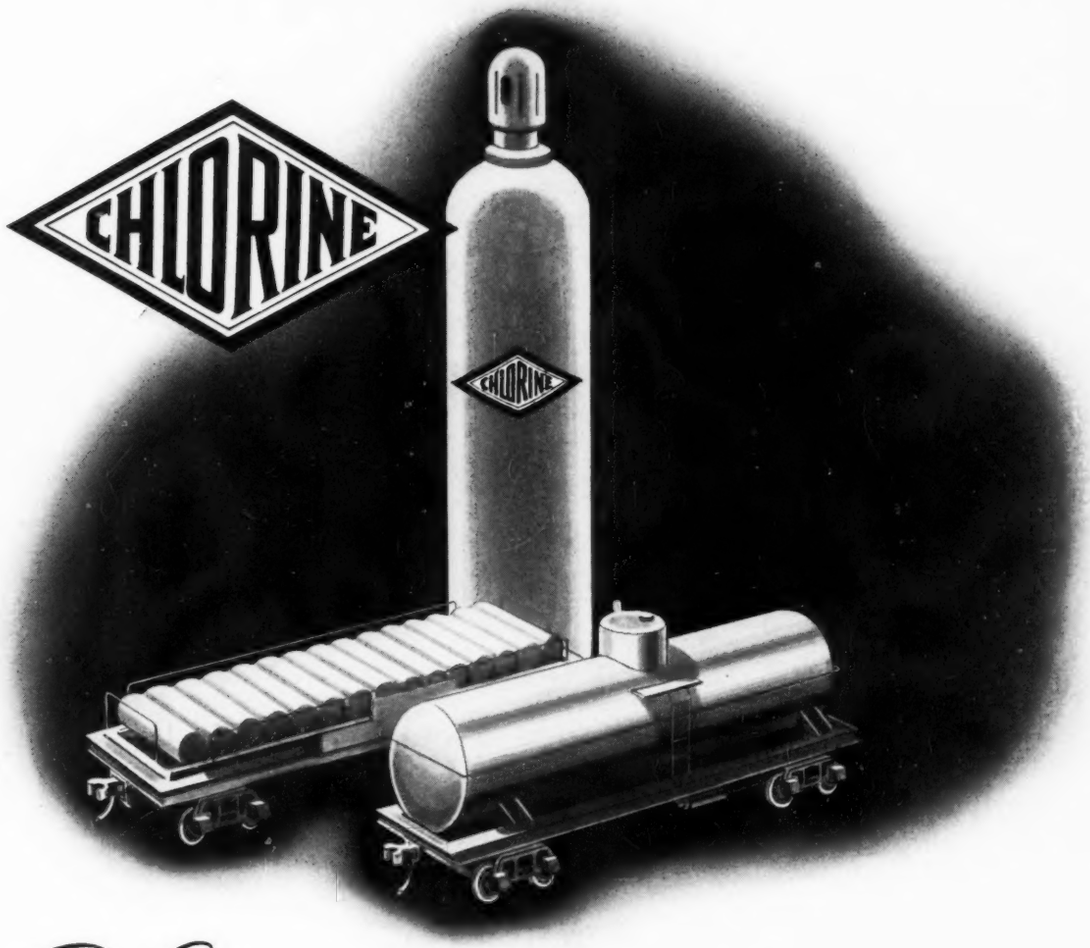
THE Mathews elbow, and the loose protection case above it, are permanent. Tough rugged cast iron, with no bolts to rust, flanges to leak, or danger of breakage from frost upheaval, they're practically everlasting. No need ever to dig them up, for the entire barrel, which contains all working parts, slips down through the protection case and then screws tight into the elbow. To inspect valve seats, to repair traffic accidents, or even to modernize the entire hydrant, just change the barrel like a spare tire. But—you have to specify Mathews hydrants. Investigate. Write for prices, full description or demonstration.

MATHEWS HYDRANTS

Made by R. D. WOOD COMPANY

Manufacturers of Sand Spun Pipe (centrifugally cast in sand molds) and R. D. Wood heavy-duty gate valves for water works

400 CHESTNUT STREET, PHILADELPHIA, PA.



Regardless OF HOW YOU USE

DIAMOND LIQUID CHLORINE

DIAMOND ALWAYS COMBINES UNIFORM PURITY WITH MAXIMUM SAFETY AND CONVENIENCE IN HANDLING

DIAMOND plays no favorites! The one-cylinder user can count on the same uniformly pure, safely delivered Liquid Chlorine as can the largest tank car user! Years of sympathetic study of YOUR problems have evolved a technique in packaging, shipping and handling Diamond Liquid Chlorine that insures safe delivery in the type of container most convenient for your use.

DIAMOND ALKALI COMPANY • PITTSBURGH, PA., AND EVERYWHERE

TWO WORDS

Solved This Sewer Problem

Two words, SPEED and DURABILITY, held the answer to this tough sewer problem. Speed was essential because the collapsed sewer was endangering private property. Engineers met both requirements by using Asbestos-Bonded ARMCO Corrugated Pipe to make a permanent replacement in only 18 hours. The expense and trouble of resorting to temporary emergency measures was averted.

The same features of ARMCO Pipe that contributed to this exceptional speed bring many advantages in normal sewer installations. ARMCO Pipe is light in weight for easy handling and low-cost hauling. Yet thanks to flexible, corrugated design, there is little danger of structural failure. And a full, special bituminous coating assures utmost durability under even the most severe sewer conditions. This coating is tightly bonded to the galvanized ARMCO Ingot Iron base metal by ARMCO's Asbestos-Bonding process. A thick bituminous pavement protects the bottom against erosion.

Try Asbestos-Bonded ARMCO Pipe for new sewer lines as well as for repairing old ones. It will save you time, worry and future maintenance expense. Write for the facts. ARMCO DRAINAGE PRODUCTS ASSN., 5033 Curtis St., Middletown, Ohio

Quick replacement of this failed sewer was needed to prevent further property damage. Yet economy dictated that corrective measures be of a permanent nature. Asbestos-Bonded ARMCO Pipe was the practical answer.

In 8 hours a new trench was dug and 188 feet of Asbestos-Bonded ARMCO Sewer Pipe delivered to the job. Ten more hours was required to install the pipe and complete the backfilling. Sturdy band couplers joined pipe sections into a continuous conduit of balanced strength and design.

ARMCO

ASBESTOS-BONDED

ARMCO SEWER PIPE

Ceiling Unlimited!

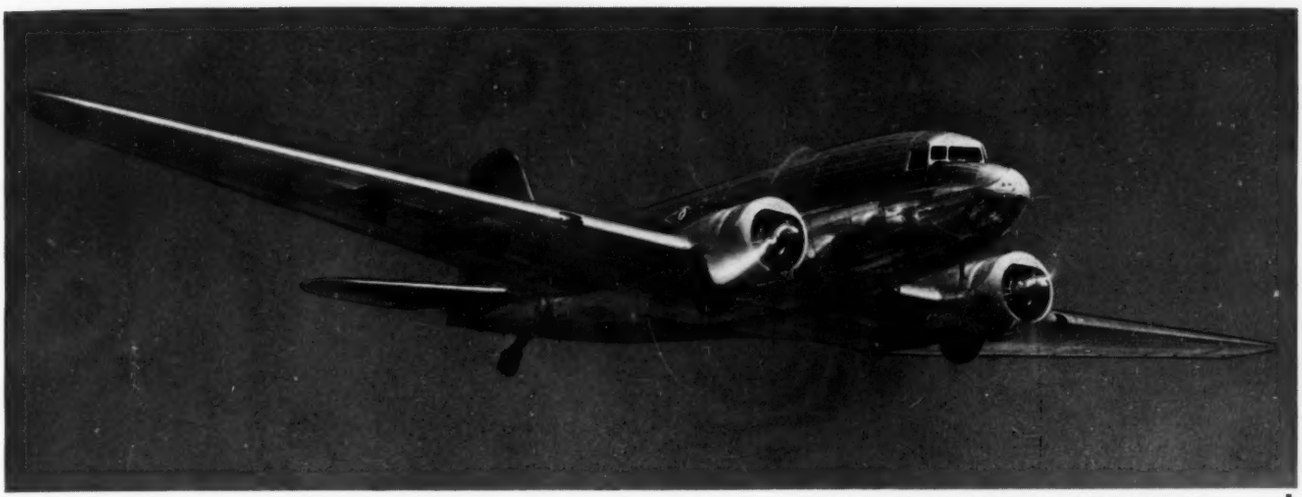


Photo: Courtesy AMERICAN AIRLINES, Inc.

Ferri-Cl_3or GIVES UTMOST VISIBILITY

HIGH FILTRATION RATES ASSURED AT LOW COST

It negotiates non-stop flights to known destinations; avoids flying blind, because the workings are visible; knows no ceiling as to the results it can obtain.

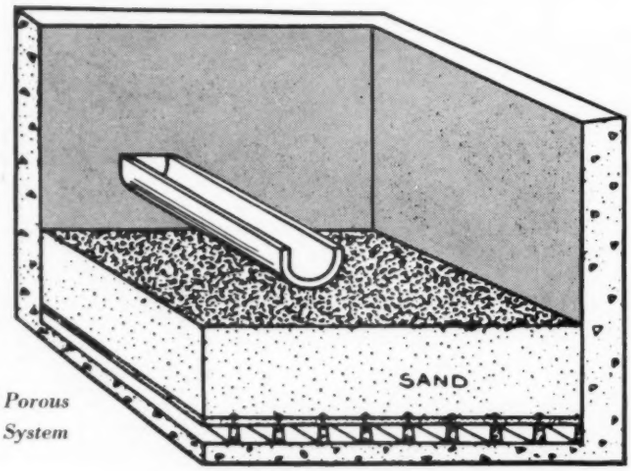
ISCO Ferri-Cl_3or (FERRIC CHLORIDE) provides an inexpensive and efficient method of dealing with plant overloads — reduces original plant investment by increasing the capacity of the sedimentation plant.

AS A COAGULANT for Sewage and Industrial Wastes, Ferri-Cl_3or is accepted as the agent most efficient from the standpoint of performance and cost for the coagulation of sludge prior to its dewatering on the filter.

•

INNIS, SPEIDEN & COMPANY Established 1816 117 Liberty Street, **NEW YORK**

CHICAGO • CLEVELAND • CINCINNATI • BOSTON • PHILADELPHIA • GLOVERSVILLE, N. Y.



The Aloxite Brand Porous Plate Underdrain System

IT'S A "NATURAL"

EVERY once in a while an idea crystallizes into a form which everyone recognizes as the simplest, most effective and most economical answer to a long felt need.

Engineers, superintendents and other water works technicians everywhere have put the Aloxite Brand Porous Plate Underdrain Systems for rapid filters in this category of "naturals." The obvious benefits of eliminating all graded gravel and other filter bottom equipment are now being proved in more than 70 installations.

Porous Plate Underdrains will save money in solving your problem whether it is constructing new filters or eliminating filter bottom troubles in old filters. Furthermore, this construction does not require materials that are not available because of the present emergency.

Write for further details.

POROUS CARBORUNDUM PRODUCTS

THE CARBORUNDUM COMPANY

REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of and indicate manufacture by The Carborundum Company)

DRESSER

master STYLE 85

BELLMASTER
DRESSER
New Saver of Time, Money, Handling
CIP
LINES

The New CIP Mechanical Joint That's All Ready "To Go"

EASY TO HANDLE • QUICKLY INSTALLED
MAKES CIP JOINTS PERMANENTLY TIGHT

Advantages at every step—before installation, during installation, after installation. That's why everyone's so enthusiastic about the new Dresser Bellmaster Joint. *Completely* factory-assembled, simplifies stocking and handling. Installed in from 2 to 5 minutes by ordinary workmen.

Note how the Bellmaster fits snugly *inside* the bell, offering complete protection against corrosion. See how this "floating joint," with its large-section resilient gasket, allows deflection of pipe in any direction and absorbs longitudinal movement caused by expansion and contraction. But get the facts first hand! Send today for a sample Bellmaster Joint. Use the coupon below.

This Coupon Brings You A Full-sized Bellmaster.

Without cost or obligation to us send a full-s
Style 85 Bellmaster Joint for our inspection. We und
stand you will pay all shipping charges.

Name.....

Title.....

Company.....

Address.....

City and State.....

DRESSER

MANUFACTURING COMPANY
BRADFORD, PA.

In Canada: Dresser Manufacturing Co., Ltd.
60 Front St., W., Toronto, Ont.

FOR SIMPLER, FASTER, EASIER JOINING OF CAST IRON PIPE

THE REX MAN—See him at our Convention Exhibit.

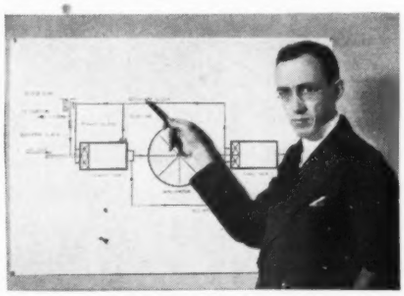
AND THAT'S NOT ALL AERO-FILTER WILL DO!

① AERO-FILTER IS SMALLER! Filter bed volume is 1/7 to 1/9 the size of conventional filters. This is made possible because of Aero-Filter's efficient distribution of sewage to the filter bed. It also has other low-cost advantages! . . . . .

② NO COSTLY PUMPING for recirculation, nor oversize primary settling tanks are required with Aero-Filter's rain-like distribution. Maintenance and power costs are lowered. Lower initial plant cost also reduces fixed charges. . . .

③ ADEQUATE PURIFICATION for any requirement—is now available with Aero-Filters. By a choice of single or two-stage design and supplementary units, any degree of effluent quality may be secured at minimum cost. . . . . .

④ THESE 49 INSTALLATIONS in both northern and southern climates — approval by state boards of health, and several years of proved service, give conclusive evidence that Aero-Filter superiority is a well established fact among men who know. . . . . .



⑤ AND AERO-FILTER SLUDGE can be concentrated in the primary tank, combining it with the primary sludge before pumping to the digesters. This reduces to a minimum the heat loss and the supernatant solids discharge due to sludge pumping. . . . . .

⑥ REX SANITATION EQUIPMENT also includes other vital equipment for the Aero-Filter plant . . . bar screens, triturators, grit collectors and washers, conveyors, Tow-Bro sludge collectors, rapid and Slo-Mixers, etc. Get copies of catalog on those items you find interesting.

Ask the Rex Man about Aero-Filters. He'll be in our booth at the convention of the Federation of Sewage Works Associations, Hotel Pennsylvania, New York, Oct. 9-10-11.

REX SANITATION EQUIPMENT

CHAIN BELT COMPANY OF MILWAUKEE

Baldwin-Duckworth Chain Belt Division, Springfield, Massachusetts • Worcester, Massachusetts
Rex Chain Belt and Conveyor Divisions, Milwaukee, Wisconsin

50TH ANNIVERSARY 1891 REX 1941 CHAIN BELT COMPANY

6 ALUMINUM, DEFENSE, AND YOU

ALCOA ALUMINUM

DEFENSE ISN'T JUST AIRPLANES!

They are first in the hearts of the people and first in the headlines. But Defense is also ten thousand other military necessities, clear across the board, and Alcoa Aluminum goes all the way across with it.

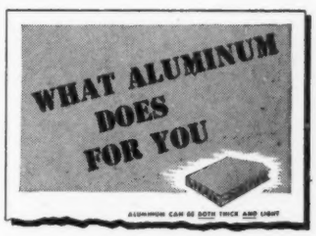
Sheets and shapes and wire; castings and extrusions and forgings, nuts and bolts and tubing and rivets; all these and more forms of Alcoa Aluminum are being chewed up by scores of industries in military applications as varied as the peace-time applications of aluminum used to be.

AND FOR THE SAME REASONS.

Before Defense, one of our advertisements to civilians started off with the headline reproduced at the right. A whole volume of economic and engineering common sense was distilled into those six words. Now, Defense is taking all the aluminum we can make because that headline is a fact.

THIS IS WHAT we were saying, *Before Defense,* to prospective buyers of Diesel engines. A great new industry was feeling its way. Properly, it was weighing the advantages of using Alcoa Aluminum. But Defense had to have those advantages right away, and civilian users of Diesels now have to wait for their aluminum.

THE FIVE WORDS in the headline of this advertisement (B.D.) at the right introduced straight talk about the fundamentals of weight saving with Alcoa Aluminum: vital reasons we thought (and think) that everybody should know. Defense hasn't time to explain that these are precisely its reasons for using aluminum; it just takes all it can get.



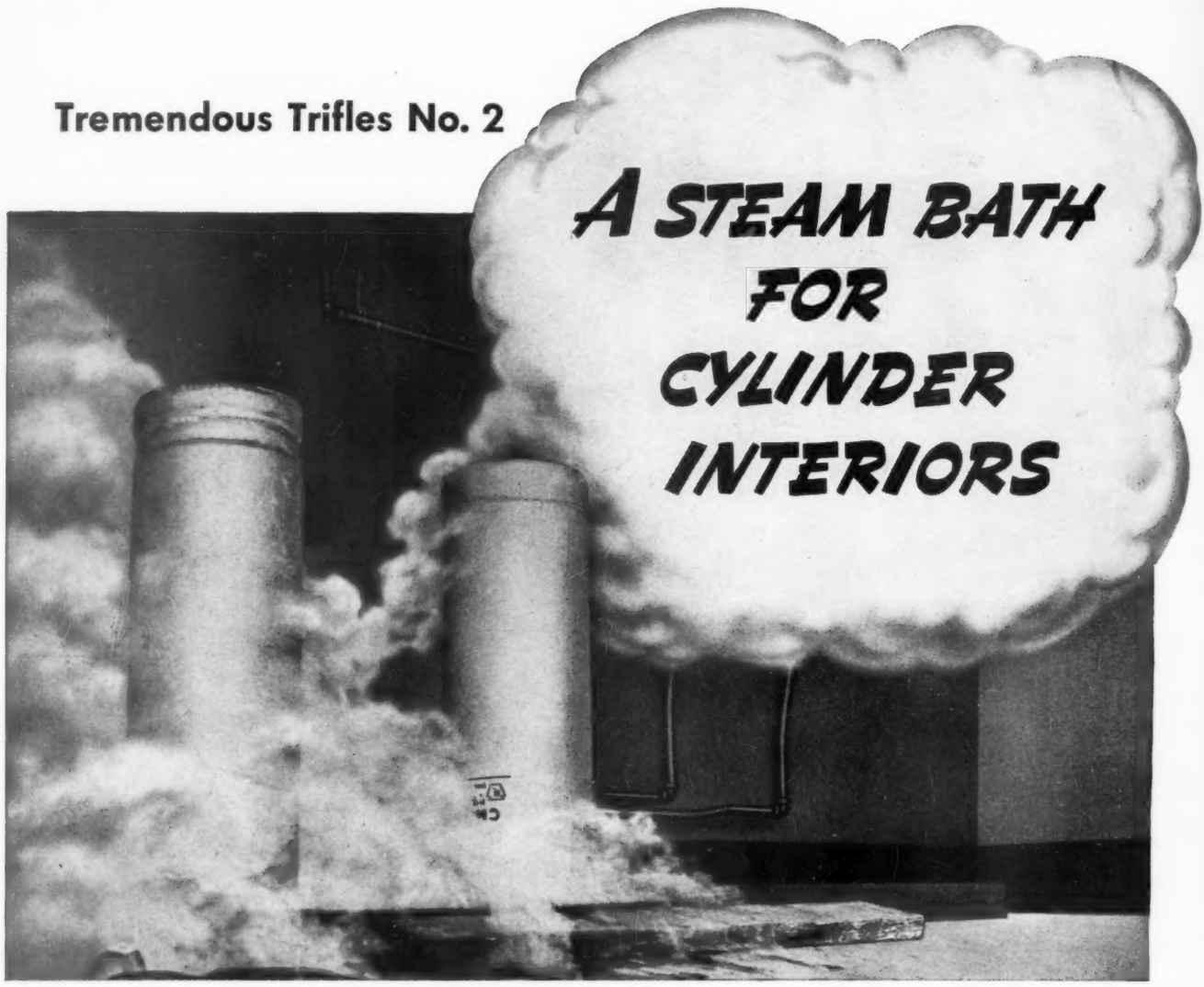
LAST MONTH DEFENSE TOOK over 50 million pounds of Alcoa Aluminum, for the simple and clear reason that certain advantages of aluminum are fundamental.

When the emergency is over, Alcoa is going to be talking the same simple language, selling the same fundamentals. And it will have still better techniques and new uses of Alloys of Alcoa Aluminum for you to put to work.

RIGHT NOW, we are in high gear for defense; our foot is on the floor board; we intend to keep it there for the duration.

ALUMINUM COMPANY OF AMERICA

Tremendous Trifles No. 2



insures clean containers for Penn Salt's clean chlorine

Dirty cylinders are purged of foreign matter and scrubbed clean before reloading. Scrubbing, followed by hot live steam and then hot bone-dry air, leaves each cylinder thoroughly clean for loading with Penn Salt's specially purified liquid chlorine. And this is merely one of the "tremendous trifles" which assure you of clean chlorine in clean containers.

All valves are reconditioned and repacked before use. Our care also includes checking, weighing, painting and double checking the cylinders for possible leaks.

And *every* cylinder is loaded only with clean chlorine, purified by the special fractionating process developed by Penn Salt engineers.

Write "Pennsylvania Salt" on your order if you want clean liquid chlorine in clean containers. And if you'd like a useful wall chart, "Handling Liquid Chlorine," to hang near your chlorinator, write us for your free copy today. Pennsylvania Salt Manufacturing Co., Widener Bldg., Philadelphia, Pa.—New York • Chicago • St. Louis • Pittsburgh • Wyandotte • Tacoma.

PENNSYLVANIA SALT
MANUFACTURING COMPANY
Chemicals
1000 WIDENER BUILDING, PHILADELPHIA

might can make right!

PURE WATER, Sanitary conditions, Protection against flood are among man's primary needs—vital to his health, well-being and happiness, and *essential to effective National Defense!*

Foremost in these services are Roto-valves and Pumps by SMITH. Be sure that you have the latest information about each product, and know *how they can help you solve your own problems!* Write for data and be an integral part of the strong force that proves that *might can make right!*

S. MORGAN **SMITH** COMPANY YORK, PA.

TO USERS OF MATHIESON CHEMICALS

★★★★★★★ ★★★★★★★

● The demand for many of our products for both direct and indirect national defense purposes has been greatly in excess of anything we had anticipated. In some cases, this greatly increased demand has made it impossible for us to take care of our customers' normal requirements. But in all such cases we are meeting the unusual conditions to the best of our ability.

We realize the serious problem that has been created for many users of Mathieson products by this emergency curtailment, and we are doing everything we possibly can to ease the situation. We are using this "open letter" as one way of asking our customers to bear with us during this emergency period.

Your business is appreciated. Your acceptance of Mathieson Chemicals has been the backbone of our success. Your orders are being filled as rapidly as the priority of defense deliveries will permit. And in the meantime we ask that you do not order more than you would ordinarily need for minimum current requirements.

★★★★★★★ ★★★★★★★

THE MATHIESON ALKALI WORKS (INC.)

60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

THEY BUILT THEIR MUNICIPAL CENTER AROUND A MILLION GALLONS OF WATER

PITTSBURGH · DES MOINES
Elevated Steel Tanks

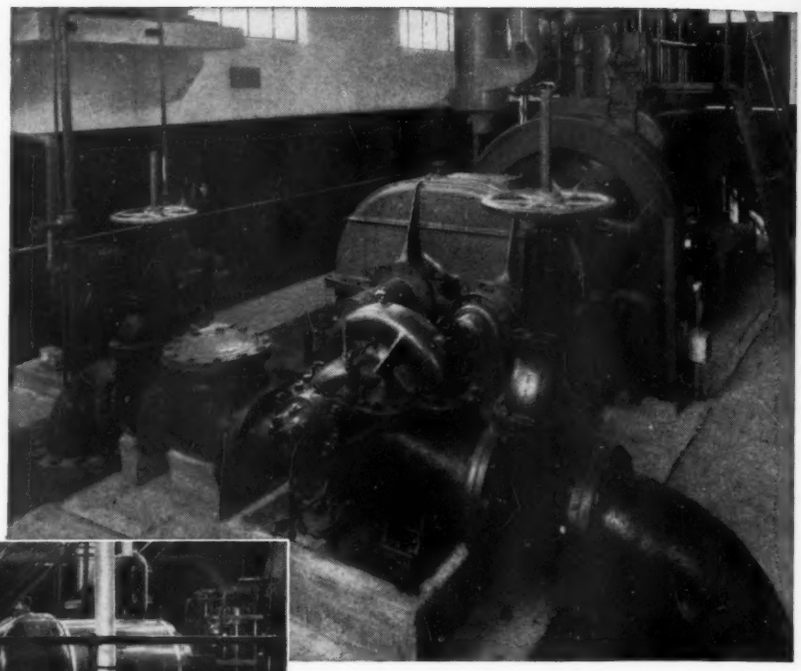
When the City of Lake, Wisconsin, decided to improve water service with elevated water storage in a P.DM Tank, an ingenious consolidation of civic departments was included in the project. The result is the interesting and handsome structure pictured above—a municipal center literally surrounding a P.DM Double-Ellipsoidal Elevated Steel Tank of 1,000,000 gallons capacity. The complete plant provides efficient storage of water—with every advantage of unfailing supply, constant pressures, and economical pump operation—together with well-integrated city offices, Council chamber, jail, filter plant, and fire department. A notable architectural distinction was achieved in the design of the building, aided by the adaptability and close cooperation of P.DM elevated tank engineering. Illustrated at right is the completed tank and tower before the tower walls were applied.

Whatever YOUR municipal water service problems may be, you are assured of the right answer when you come to Pittsburgh-Des Moines. We invite your inquiries!

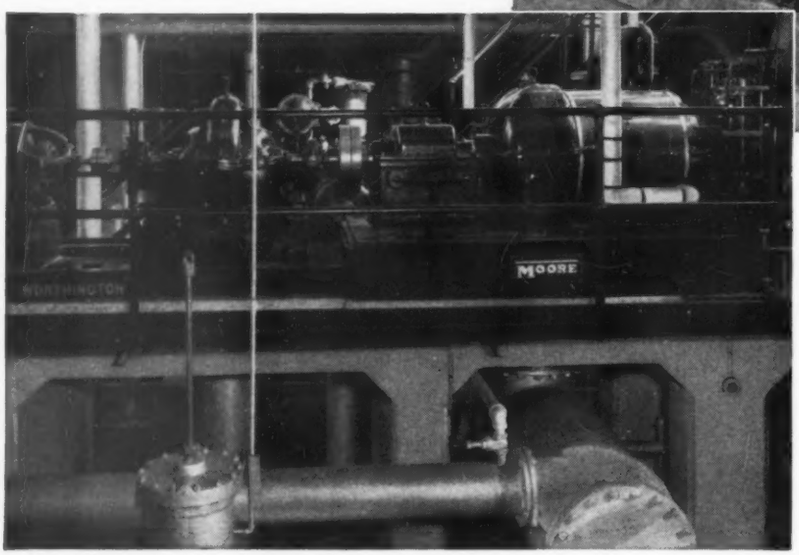
PITTSBURGH · DES MOINES STEEL CO.

PITTSBURGH, PA. 3418 NEVILLE ISLAND—DES MOINES, IOWA, 919 TUTTLE STREET
NEW YORK, ROOM 918, 270 BROADWAY · CHICAGO, 1222 FIRST NATIONAL BANK BUILDING
DALLAS, 1223 PRAETORIAN BUILDING · SAN FRANCISCO, 625 RIALTO BUILDING
SEATTLE, 1126 EIGHTH AVENUE, SOUTH

A COMPREHENSIVE SERVICE *for* WATER SUPPLY



Serving the City of Meridian, Mississippi, this Worthington pumping unit was engineered and installed by A. M. Lockett & Co. Ltd., New Orleans, and delivers 5,000,000 gallons per day against a total head of 225 feet. It is driven by a Worthington 260 horsepower gas engine which requires less fuel gas for its operation than is needed to keep the old steam plant hot.



At the Hackensack (N. J.) Water Company's New Durham Station (shown at the left) this Worthington pumping unit is used for economical booster operation with capacities varying from 2,000,000 to 8,000,000 gallons per day against heads up to 162 feet. The 307 hp. Worthington-Moore geared steam turbine exhausts into a high vacuum Worthington condenser equipped with a Worthington two-stage steam air-ejector. The condensate pump is driven by a water turbine supplied with water from the main pump. The circulating pump is driven by the main turbine and is mounted on a small D.C. generator incorporated in the unit to furnish current for station lighting. All pumps and the water turbine are also by Worthington.

CENTRIFUGAL PUMPS
STEAM AND POWER PUMPS
TURBINE WELL PUMPS
SUMP AND DRAINAGE PUMPS
DIESEL ENGINES
GAS ENGINES
CONVERTIBLE GAS-DIESEL ENGINES
STEAM TURBINES
STEAM CONDENSERS
CONDENSER AUXILIARIES
FEEDWATER HEATERS
STEAM-JET EJECTORS
WATER PURIFICATION EQUIPMENT
STATIONARY AIR COMPRESSORS
PORTABLE AIR COMPRESSORS
ROCK DRILLING EQUIPMENT
CONSTRUCTION AIR TOOLS
V-BELT DRIVES
AIR LIFT SYSTEMS
WATER METERS

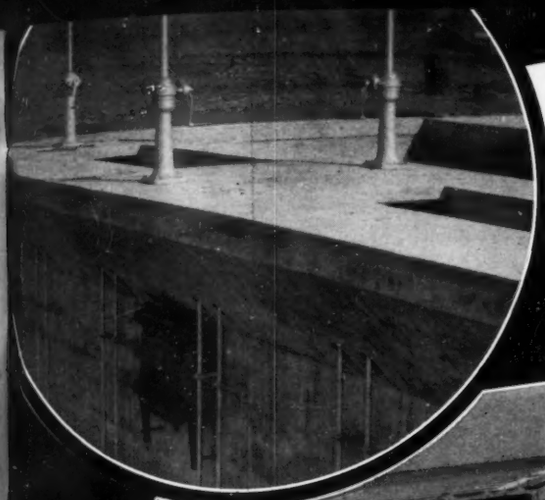
THESE two modern Worthington water works installations are but representative of the hundreds which are efficiently serving progressive municipalities throughout the country.

Worthington equipment for water supply comprises a most comprehensive line... not only main units of every type and size, and for every type of drive, but all auxiliary equipment... *a complete service with undivided responsibility.*

WORTHINGTON PUMP AND MACHINERY CORPORATION
General Offices: **HARRISON, NEW JERSEY**
Branch Offices and Representatives in all Principal Cities

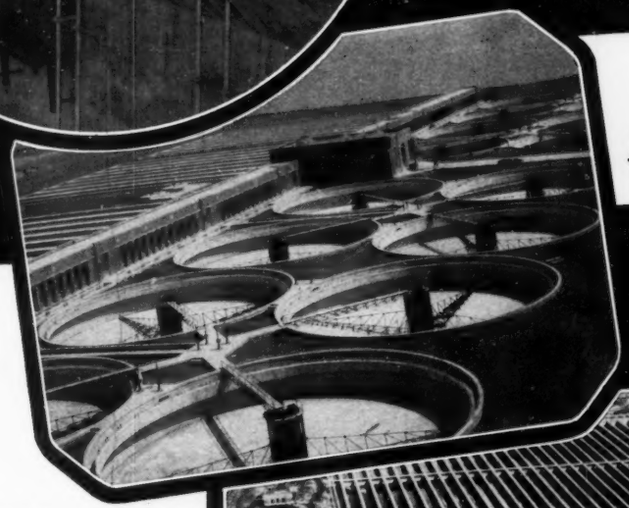
WORTHINGTON

CP1-3



AT WASHINGTON

MUELLER-COLUMBIAN EQUIPMENT WORKS FOR THE NATION'S CAPITOL



AT CLEVELAND

MANY DOLLARS WERE SAVED THROUGH RECOMMENDATIONS OF MUELLER ENGINEERS

ADOPTED AS STANDARD EQUIPMENT

ALL OVER THE U.S.

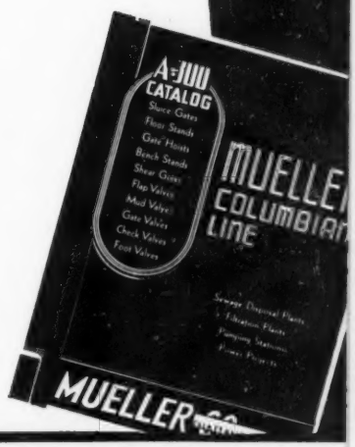
AT CHICAGO

YOU'LL FIND MUELLER EQUIPMENT AT THE WORLD'S LARGEST ACTIVATED SLUDGE PLANT.

and Minneapolis, and Milwaukee, and Dallas, and many others—just a few of the cities where Mueller-Columbian installations have left a record, not once, but many times, of satisfactory performance year after year.

Of course there is good reason for this. Careful selection and control of material, extreme ruggedness of design and precise manufacturing methods mean that Mueller-Columbian Equipment will meet every expectation of performance and durability. Every piece of equipment must meet rigid tests far in excess of actual operating conditions before shipment is made from the plant.

The practical experience of Mueller Co. Engineers is yours for the asking. Recommendations, plans and estimates are cheerfully furnished without obligation.



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MUELLER CO.

CHATTANOOGA, TENN.

Mueller Co., Dept. S-1
Chattanooga, Tenn.

Gentlemen:
Please send me my copy of your A-300 Catalog.

Name _____

Position _____

Address _____

Here's Proof from Calgon Users...

Articles in the technical press report the excellent results obtained with Calgon

RED WATER STOPPED by simple treatment

Chappaqua, N.Y., supplants lime with Calgon and complaints stop.

This paper describes how "red water" flowing from the faucets of house services in Chappaqua has been eliminated by the use of Calgon at the treatment plant. The staining of tubs and bowls has stopped, and this desirable result has been obtained even in dead ends.

From American City, June 1941, Page 20.

PREVENTING CORROSION with lime and Calgon

At this plant, lime is added to increase the pH from 5.2 to 7.2–7.6. Until Calgon was introduced into the feeding system the lime plant of the Freeport, Long Island, Water Department was shut down on an average of every five weeks to clear out the hard lime deposit. After Calgon was used, there was such an improvement that the plant has now been working without interruption since March 25, 1940.

From Public Works, July 1941, Page 13. "My experience with Lime and Calgon in the Prevention of Corrosion" by A. C. Southard.

STABILIZING WATER after lime treatment

This paper is a general discussion of the new lime-zeolite softening plant which has been built to treat the domestically used portion of the water brought in through the Colorado River Aqueduct to Los Angeles. It describes the use of Calgon in stabilizing the water following lime treatment and before passage through the zeolite.

From Western City, July 1941. "The New Water Purification Plant of the Metropolitan Water District of Southern California."

"TAMING WILD WATER" at Sumter, S.C.

That is the way Mr. Ellis describes the elimination of "red water" with a feed of 4 ppm. of Calgon to well-water containing 3.8 ppm. of dissolved iron. Previously, when this well was used, in periods of acute water shortage, complaints of "red water" poured in by hundreds. Since Calgon's introduction, the well has been in constant service, and no complaints have been received.

From Water Works & Sewerage, June 1941, Page 255. "Calgon for Corrosion Control at Sumter, S. C." by F. K. Ellis, Supt. of Public Works Dept.

PREVENTING SCALE in hot water heaters

At the new Wichita, Kansas, plant, much difficulty was experienced with rapid scale formation in hot water heaters. Mr. Rogers explains in detail the tests which were made with Calgon and the good results it has given in preventing heaters from clogging.

From Journal American Water Works Assn. July 1941, Page 1233. "Operation Problems in the New Wichita Water System" by M. E. Rogers, Supt. of Production.

THESE five articles—all in current magazines – show the intense interest in Calgon* . . . and its effectiveness in solving four major water problems: (1) It controls corrosion, (2) prevents precipitation of dissolved iron, (3) stabilizes water after lime or lime soda softening, (4) prevents scale formation from high-bicarbonate waters – AND DOES THESE THINGS AT SURPRISINGLY LOW COST.

Drop us a line and we'll send you complete technical information.

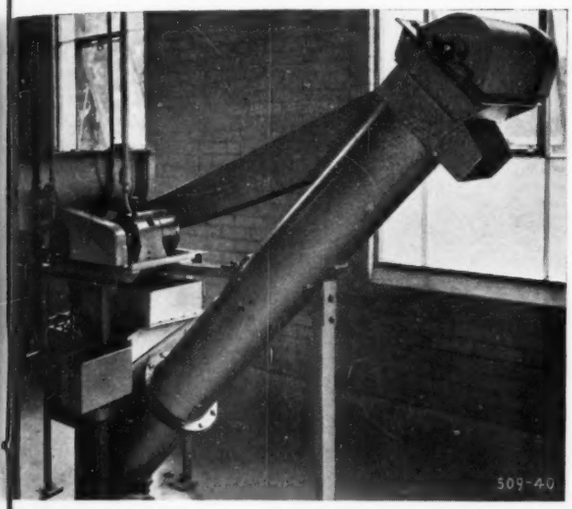
*Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products

calgon, inc.
300 ROSS ST. PITTSBURGH, PA.

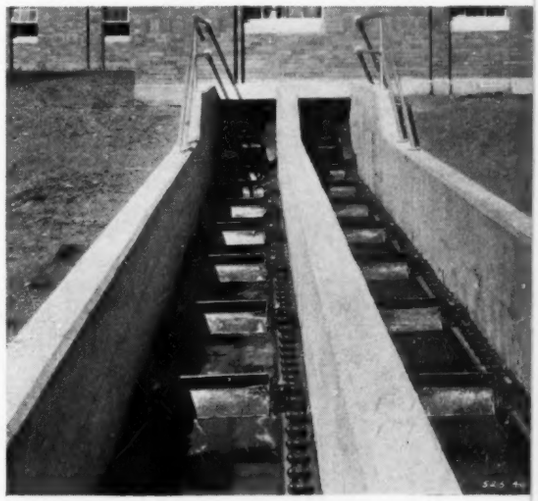
PROVED EQUIPMENT

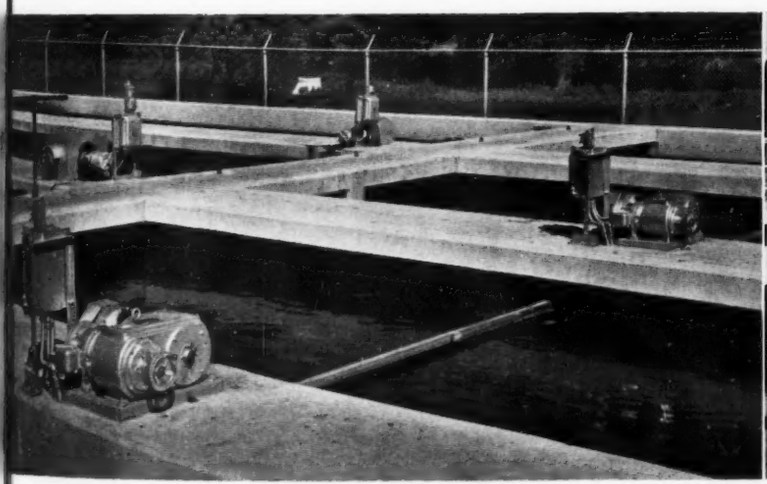
FOR SEWAGE AND WATER TREATMENT IN MUNICIPAL AND DEFENSE PROJECTS

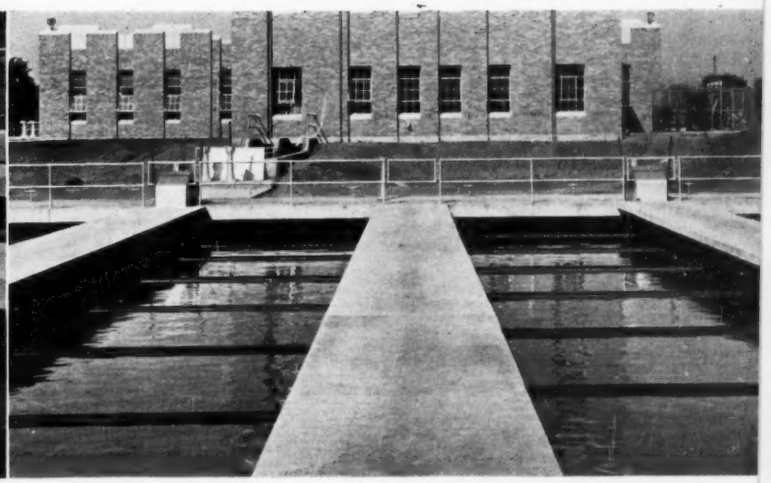
Many successful installations . . plants serving a population 2500 to several million . . bear evidence of the carefully-designed units in the Jeffrey line and of their low-cost operation and performance. Our sanitation engineers are specialists . . they are prepared to offer technical information on both equipment and plant design.

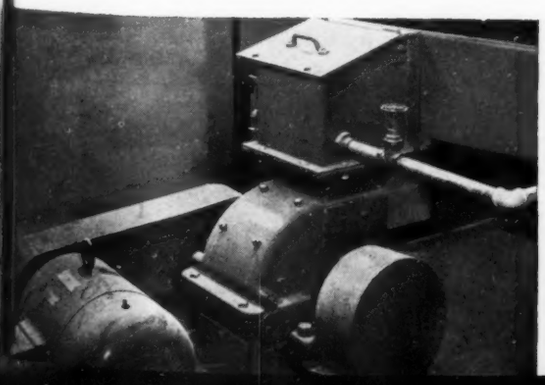


- Bar Screens — mechanically cleaned — variety of sizes
- Chemical feeders — electric vibrating types — weigh within 1%
- Floctrols—controlled flocculation—tapered mixing—little short-circuiting
- Screenings Grinders — most sanitary method of disposal—low maintenance
- Grit washers—will remove 70 to 80% of putrescible solids—two types (see photo at left)
- Sludge collectors—for rectangular tank design—straight-line flow
- Scum removers — cross or longitudinal types
- Sludge elevators—raise and feed sludge —maintain uniform level in tank
- Grit collectors—v-bucket, scraper or combination—remove grit continuously during deposit periods
- Engineering data and typical layout upon request









A few typical installation views are shown here. Jeffrey employs only the most modern methods and the latest in mechanization . . will help you effectively and adequately solve your treatment problems. May we hear from you?

SANITARY ENGINEERING DIVISION

THE JEFFREY MANUFACTURING CO

996-99 North Fourth St. **Columbus, Ohio**

Baltimore	Chicago	Detroit	New York	Salt Lake City
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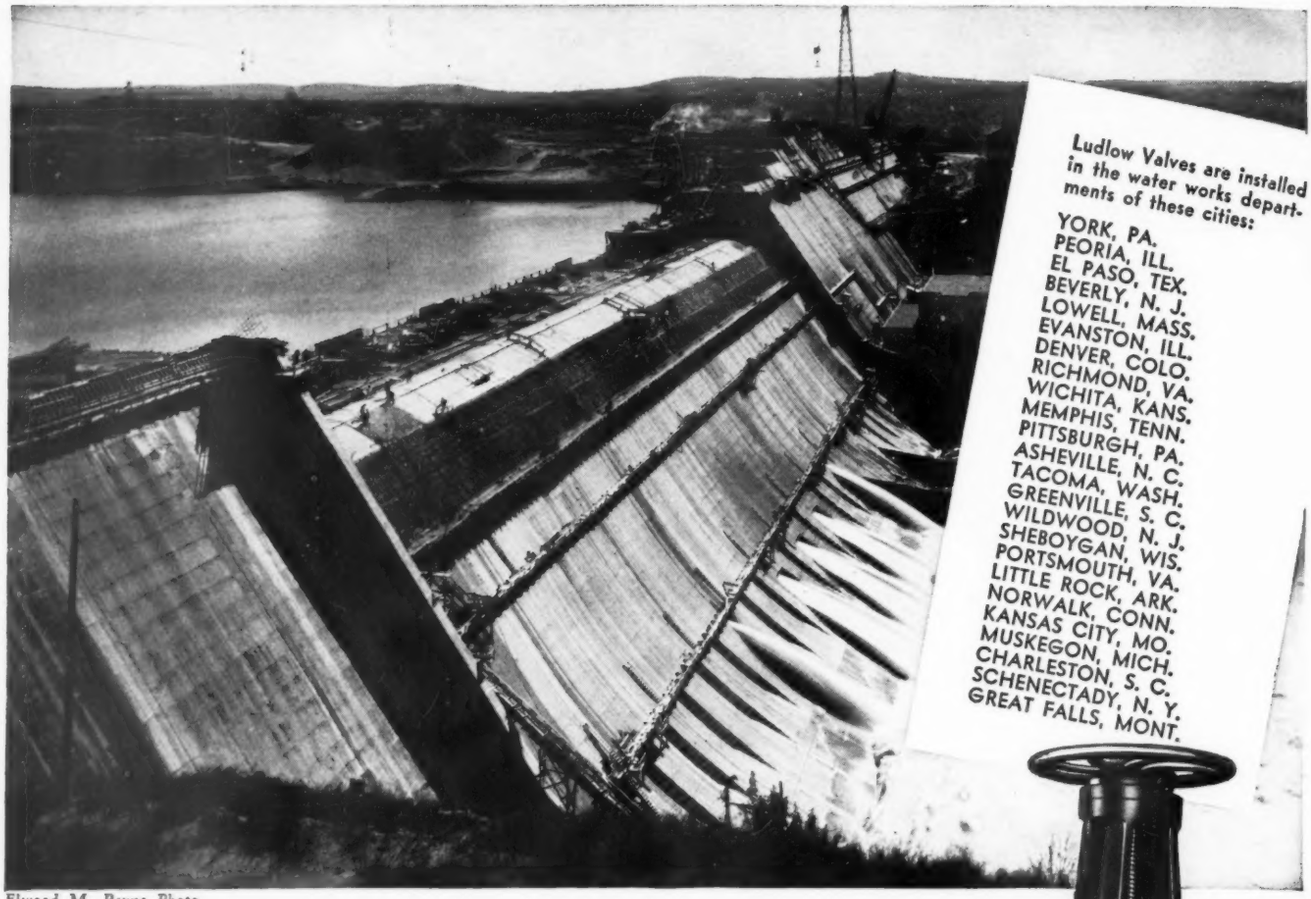
Jeffrey Mfg. Co., Ltd., of Canada—Head Office and Works: Montreal



Elwood M. Payne Photo

LUDLOW VALVES AT WORK

Ludlow Valves are the standard choice of water works departments in many cities. Installed throughout the entire system, they assure the unfailing and economical service that is essential to the safety and health of the cities they serve.

Ludlow developed and perfected the principle of the double-disc parallel seat valve. This construction offers positive closure, easy operation, self-cleaning seats, and easy replacement of parts. Many Ludlow Valves are still in service after as many as 40 or 50 years of operation.

LUDLOW SLIDE GATE HYDRANTS. **The slide gate principle insures complete security in fire hydrants. Ludlow Hydrants provide *quick water* with least possible shock, proper drainage, no flooding, and easy inspection and servicing. Ludlow Valves and Hydrants are fully described in Catalog No. 201. Write for a free copy today.**

LUDLOW VALVES

THE LUDLOW VALVE MFG. CO., INC. • TROY, NEW YORK

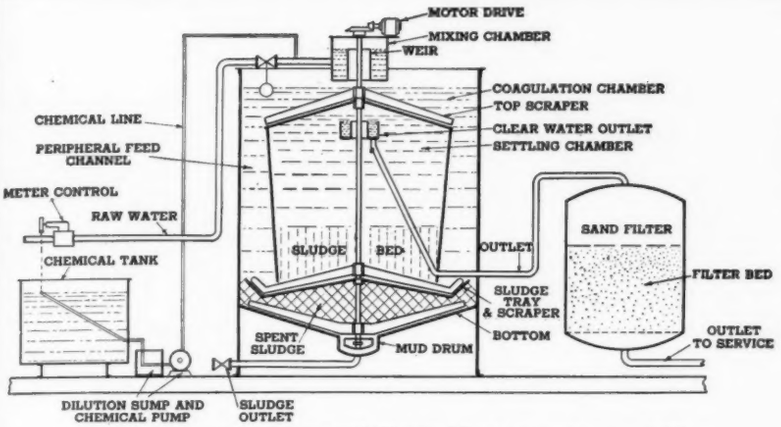


Diagram of Graver Reactivator with Chemical Tank, Proportioner and Filter

Water Conditioning 10 Times Faster with GRAVER *REACTIVATOR**

Other Graver Water Conditioning Equipment

Graver Pressure Filters

Used for removal of suspended solids from water. Also used in combination with Graver Aeration Equipment for removal of iron.

Graver Zeolite Water Softeners

Will provide a water of zero hardness or by blending with raw water will provide desired degree of hardness.

Graver Hot Process Softeners

For power plant work. Complete chemical treatment and continuous de-aeration delivers to the boiler plant a water free of scale forming elements and corrosive gases.

Graver Swimming Pool Equipment

Provides continuous filtration and sterilization of pool water. Pool can be operated through a whole season without water change.

BY UTILIZING precipitated matter for clarifying, an improved process of coagulation, and automatic meter control of chemical flow, the Graver Reactivator actually has 10 times the water conditioning capacity of conventional systems of comparable size.

This amazing process also achieves a higher degree of clarification, greater reduction of hardness, uniformity of output. It requires less operator attention, and provides important economies in initial cost and operating expense.

Used as a clarifier it is capable of reducing suspended solids to a minimum; as a softener it will reduce hardness to 1½ to 2 grains in less than one hour.

Study the diagram above and consider the opportunities for accelerated performance and operating economy provided by these exclusive Graver features:

- **Upward Sludge Filtration.**
- **Utilization and reactivation of flocs for clarification.**
- **Accurate meter control of chemicals automatically adjusting charge to flow of water.**
- **Proportion of chemical ingredients varied by simple manual adjustment to meet varying quality of raw water.**

Get the complete details about this important development in water conditioning. Send for bulletin today. Write Graver Tank & Mfg. Co., Inc., 5009 Tod Avenue, East Chicago, Ind.

• • •

Graver designs and builds equipment to meet all sorts of water conditioning requirements. Whatever the nature of your problem, Graver engineers undoubtedly have the answer. Send water samples for analyses. Put your problems up to Graver today.

* *Patented and Patents Pending*

GRAVER

CLARIFIERS
WATER CONDITIONERS
CHEMICAL PROCESS EQUIPMENT

GRAVER TANK & MFG. CO., INC.
NEW YORK CATASAUQUA, PA. EAST CHICAGO, IND. Cable Address GRATANK CHICAGO TULSA

HOW TO KEEP YOUR PLANT GOING WITHOUT INTERRUPTION!
PLEASE PASS ALONG
While this bulletin is written primarily for the guidance of maintenance workers, its purpose and its contents may be of interest to:
General Supt.
Supt. of Maintenance
Maintenance Foreman
Master Mechanic
Foreman Pipe Fitter
Store Keeper
PIPING POINTERS TO KEEP EQUIPMENT ON THE JOB!
CRANE
For Defense
TREAT PIPING RIGHT!
AN AID TO DEFENSE
No. 1 of a series of bulletins on how to keep your plant going without interruption. Issued for maintenance men everywhere by Crane Co.

HERE'S A NEW CRANE SERVICE

TO HELP YOU AVOID PLANT INTERRUPTIONS

Crane announces publication of a new series of Shop Bulletins designed to help you train new maintenance men and improve the work of veterans. Bulletin No. 1 is now ready. It covers workmanship—shows a lot of practical hints on how to install and service piping equipment. Ask your Crane Representative—or write us—for copies to be distributed among your maintenance force.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

BUILDERS
RECORDING·INDICATING·CONTROLLING
Instruments

VENTURI METERS — *for use in sewage plants*

In the well-operated sewage disposal plant the aim is not only to reach and maintain the highest efficiency but to constantly experiment to lower the "cost per million gallons." Manifestly, it is essential to *know* continuously, and *not to guess,* the performance of each main unit; and for much of this work, the Venturi Meter is the accepted measuring device.

Venturi Meters are used: to indicate, record, and totalize the flow of raw sewage into the plant; to measure the flow of sewage and sludge to various parts of the process; and for air measurement.

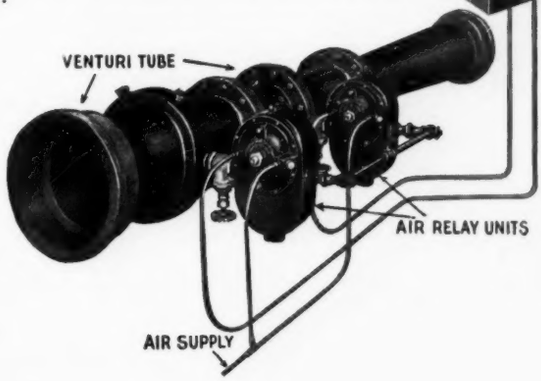
Plant efficiency records are based on these measurements.

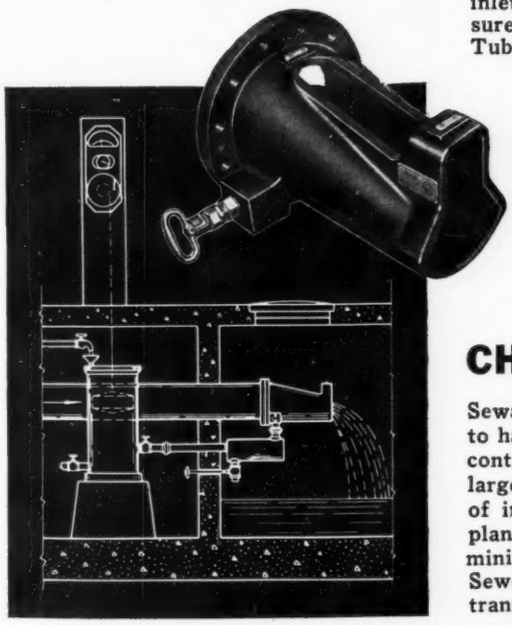
Meters showing output of centrifugal pumps and blowers provide accurate means of determining when efficiency falls off and repairs are needed. (Bulletin 287).

BUILDERS AIR RELAY

for metering sewage and sludge, solves the problem of intra-plant transmission.

Eliminates sediment tanks, detached wells, float pipes and head pipes; heavy piping replaced by small copper tubes . . . Instruments may be placed up to several hundred feet away from Venturi Tube, or may be grouped with other instruments on central panel regardless of hydraulic gradient conditions . . . Maintenance reduced to minimum; sediment-bearing liquid positively prevented from entering air piping or instrument chambers . . . Accuracy and sensitivity are noticeably improved . . . Time-proved mercury U-tube principle for instrument operation using BOTH inlet and throat pressures from Venturi Tube. (Bulletin 316).





KENNISON NOZZLE — *for open flow*

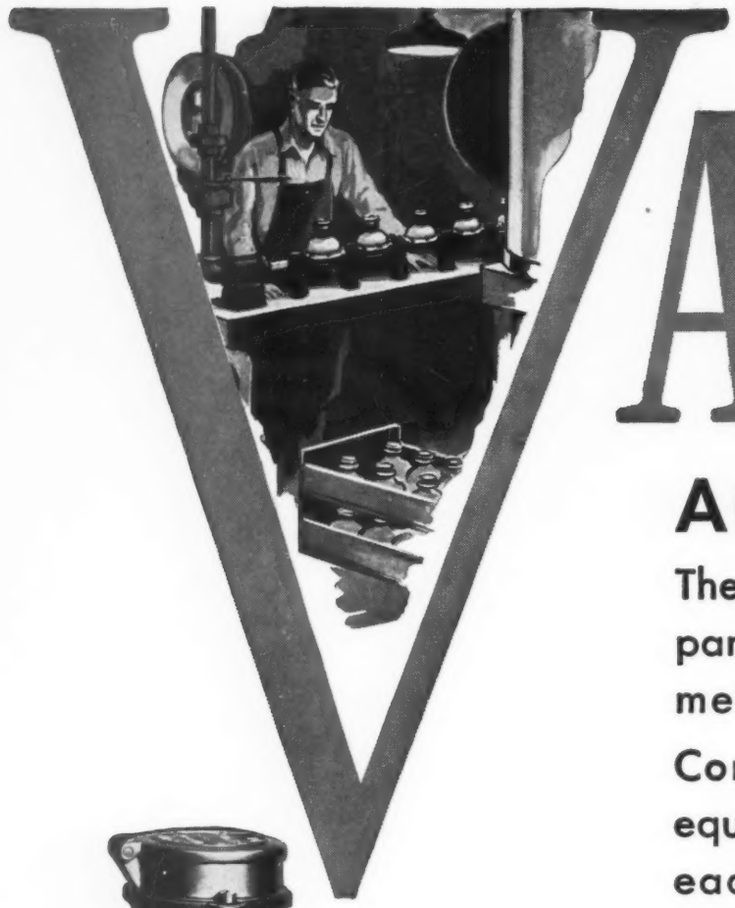
Accurately measures flow in partially filled pipes and open channels. Simple, economical, accurate, and trouble-free, Kennison Nozzles have been widely installed for measuring raw sewage, sludge or effluent. Available in sizes from 6" to 36" diameter. (Bulletin 334).

CHRONOFLO METERS — *for distant transmission*

Sewage disposal plants frequently cover large area and it may be desirable to have readings of flow rates, tank levels, valve positions, etc., brought to a control center. The Chronoflo Meter is particularly suitable for meeting a large variety of requirements involving direct transmission and summation of individual meter readings. For example, at a sanitary district disposal plant serving two cities, Chronoflo Meters are installed not only at the Administration Building of the Disposal Plant, outside City No. 2, but at the Sewer Maintenance Office of City No. 1, ten miles away, also! All of the transmission is over regular telephone channels. (Bulletin 320.)

Illustrated Bulletins available, address

BUILDERS - PROVIDENCE, INC.
(DIVISION OF BUILDERS IRON FOUNDRY)
PROVIDENCE . . . RHODE ISLAND



VALUE

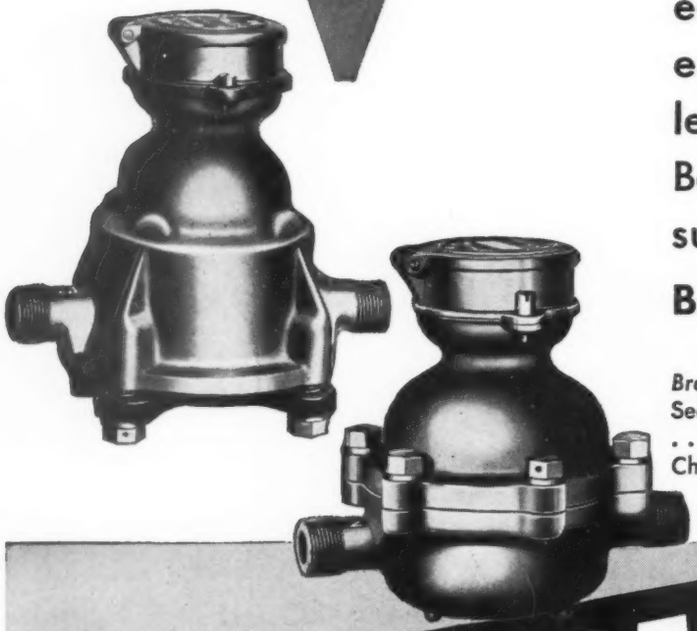
ACCURACY . . .

The Badger Meter Mfg. Company pioneered higher water meter accuracy standards.

Constant improvements in equipment have been made each year to maintain this leadership . . . In specifying Badger Meters you are assured of greater accuracy.

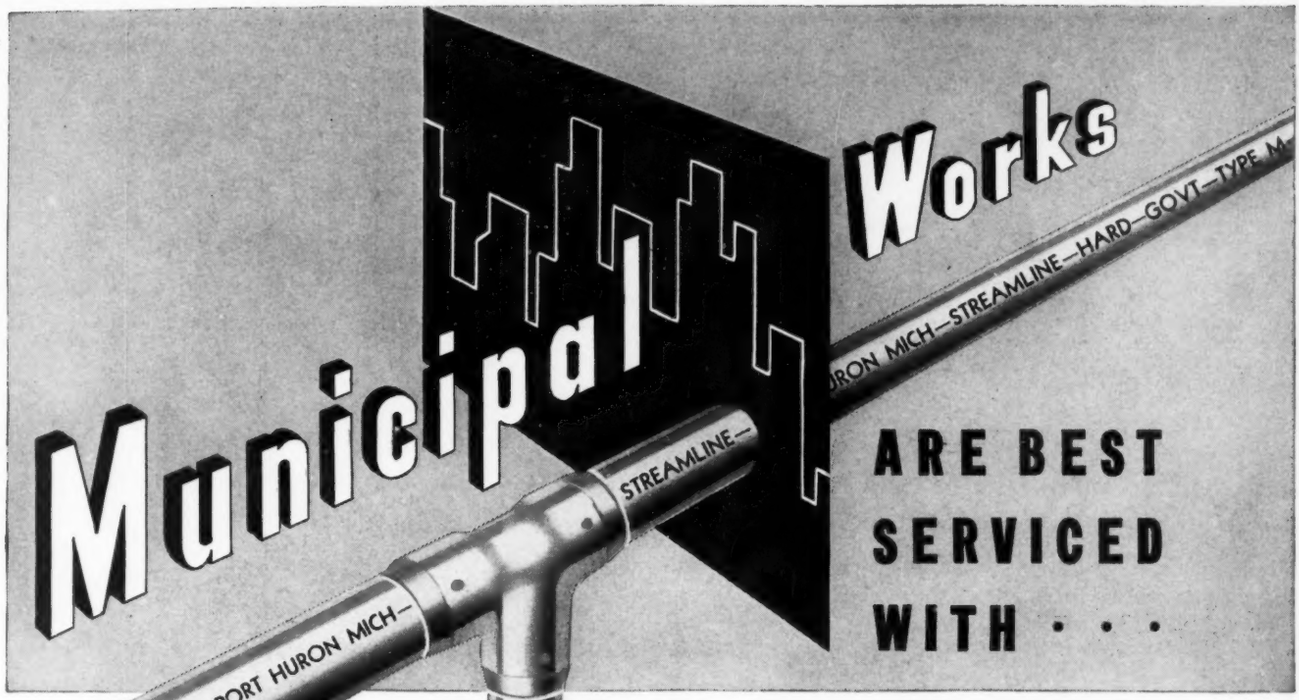
BADGER METER MFG. CO.
MILWAUKEE, WISCONSIN

Branch Offices: New York City . . . Tampa, Fla. . . . Seattle, Wash. . . . Savannah, Ga. . . . Kansas City, Mo. . . . Marshalltown, Iowa . . . Los Angeles, Calif. . . . Chicago, Ill. . . . Waco, Texas . . . Philadelphia, Pa.



DURABILITY
DEPENDABILITY
SENSITIVENESS
LOW COST MAINTENANCE

BADGER *Water* METERS


Municipal Works
ARE BEST SERVICED WITH . . .
STREAMLINE
—MUELLER BRASS CO—PORT HURON MICH—
—MUELLER BRASS CO—PORT HURON MICH—STREAMLINE—HARD—GOVT—TYPE M—

AFFORDS THE GREATEST RESISTANCE TO

RUST
LEAKS
VIBRATION
CORROSION
CLOGGING

★

STREAMLINE

TRADE MARK REG. U. S. PAT. OFFICE

COPPER PIPE AND FITTINGS

● An installation of STREAMLINE Copper Pipe and Solder Type Fittings compares very favorably in cost with ferrous Pipe, yet, with the exception of abnormal soil and water conditions, it never has to be replaced due to rust or clogging. The pipe joint is actually the strongest point in the line—constant vibration, resettlement of the fill, etc., has no effect upon it.

STREAMLINE Copper Service Pipe connected with STREAMLINE solder fittings represents one of the lowest cost forms of insurance that water works officials, who are responsible for the return on a heavy capital investment, can adopt.

A STREAMLINE installation is the most efficient for water works use, for general plumbing and heating either new or replacement, and for many applications in filtration and sewage disposal plants.

When your city plans call for pipe and fittings for any purpose, consider STREAMLINE materials carefully before you buy.

STREAMLINE
PIPE AND FITTINGS DIVISION
MUELLER BRASS CO.
PORT HURON, MICHIGAN

BE SURE YOU BUY ENOUGH HYPO FEEDER CAPACITY — ESPECIALLY IF YOUR PLANT IS PUMPING OVER 100 G.P.M.

When buying a hypochlorinator be sure you get one of adequate capacity. Under-sized hypo feeders force operators to use high strength hypo solutions. High concentrations of hypochlorite encourage corrosion of the feeder and surroundings. Thick solutions are more likely to plug up valves, injection pipes, etc.

This advice results from recent inspection of a 175 gpm water pump on which was cross connected a "too small" hypochlorinator. This unit had a maximum injection rate of only 12 strokes per minute, capable of feeding only 1¾ gallons solution per hour. Result: forced use of high strength, hard-to-handle, hypo solution, which corroded the unit, plugging the feeding system throughout. This is the sad tale of a hypochlorinator inadequate for its job. There would not have been a failure if a high capacity %Proportioneers% Chlor-O-Feeder had been on the job!

Look at these specifications for %Proportioneers% amply sized stock units:

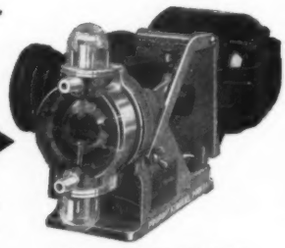
(1) DeLuxe Chem-O-Feeder

10 gallons per hour feeding capacity at 40 strokes per minute. More reagent capacity than any plant requirements unless plant is near 1½ mgd capacity and deserves a gas chlorinator. This high capacity Chem-O-Feeder costs only $255 complete — F.O.B. Providence.

DeLuxe Chem-O-Feeder mounted on Mot-O-Driver

(2) Heavy Duty Midget Chlor-O-Feeder

5½ gallons feeding capacity per hour at 36 strokes per minute. "Plenty big" for most "hypo sized" plants and hence able to use weak solutions with no corrosion or plugging troubles. Costs only $195 F.O.B. Providence.



Heavy Duty Midget Chlor-O-Feeder

Compare all hypo feeders on the market with %Proportioneers%. Insist on knowing GALLONS PER HOUR FEEDING CAPACITY. On this basis, wise buyers will specify %Proportioneers% Feeders and will not get caught short. You can be sure of ample capacity if you get "plenty" strokes per minute on your feeder!

State maximum gallons per hour reagent capacity required — or to be doubly sure, just write or 'phone:

%PROPORTIONEERS INC.% PROVIDENCE, R. I.
9 N. CODDING STREET

WATER WORKS & SEWERAGE

PUBLICATION OFFICE
330 South Wells Street, Chicago, Ill.
E. S. Gillette, Publisher

EDITORIAL OFFICE
155 East 44th Street, New York, N. Y.
L. H. Enslow, Editor

COMING!

"The New Filter Plant of Atlanta"
Will be featured in our October issue. This article which describes the plant, with particular reference to the unusual and novel features of design, equipment and methods of operation, is to be contributed by—
H. F. WIEDEMAN, Designing Engineer,
and
PAUL WEIR, Supt. of Filtration,
Atlanta, Ga.

"The Care and Maintenance of Distribution Systems"
Is a paper which an experienced and progressive manager of a well operated water utility of moderate size was asked to prepare for use in operator's short schools. We consider it a well rounded out contribution which will prove of interest and value to operators of all sizes of water utility systems, and particularly so to the small system manager and those who have had limited operating experience. The author brands it as "elementary," but it is just the type of paper which we have been seeking for the benefit of our newer readers. The author—
FRANK C. AMSBARY, JR., Sup't,
Illinois Water Service Co., Champaign, Ill.

"Sludge Pumping"
Constitutes a problem in a number of sewage treatment plants. The Reference and Data Section of our June issue contains an article which gives many pointers and helpful suggestions in sludge pumping. We have heard the author requested to contribute the forthcoming article discuss the pumping of sludge and believe that because of his varied and close observations, and his first hand experience with this problem, his contribution will add considerable up-to-the-minute information of practical value to designers as well as to operators. The author—
STANLEY E. KAPPE, Sanitary Engineer,
The Chicago Pump Co., Washington, D. C.

"A Pipe Cutting Machine—That Is"
The writer of this article has travelled in several countries, and has seen and used many methods of cutting cast-iron pipes, and used many machines for that purpose. He has only recently come onto a pipe-cutter here in America that a few of our readers have ever heard of. This machine is, in his opinion, the most satisfactory cutter of cast iron pipes (in the ditch or out) that he has ever had experience with. The machine, its adaptability, and its performance is described by—
BRUCE HARKNESS, Engineer,
Tate Pipe Linings, Inc., Andover, Mass.

"Root Control With Sulphate of Copper"
Is a recital of experiences of Ridgewood, N. J., in eliminating root blockages in sewers with copper sulphate crystals added through house toilets. Not alone did the trials chemical poisoning free the lateral sewers and house connections of the obstruction, but the effect was to produce a much fresher sewage more economically dealt with at the treatment plant. The fact that the copper salt also destroyed sulphate splitting organisms adhering to the sewer walls resulted in a worthwhile chlorine economy for odor control at the plant. The author—
JOHN W. HOOD, Superintendent,
Sewage Treatment Works, Ridgewood, N. J.

"Dosage Control in Sewage Chlorination"
Is a paper which contains many pointers and suggestions of interest to all operators who have charge of plants at which chlorination of sewage or effluent is practiced. The contents of this paper, based on adequate experience of trained operators at the Buffalo Sewage Treatment Plant, reveals procedures developed to secure reliable and effective chlorination with the most economical use of chlorine. A section also deals with the maintenance of chlorinating equipment. The authors—
DR. GEORGE E. SYMONS, Chief Chemist,
J. W. JOHNSON, Ass't Wks. Supt.,
R. W. SIMPSON, Sanitary Chemist.
The Buffalo (N. Y.) Sewer Authority.

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H. P. GILLETTE, President; E. S. GILLETTE, Vice Pres. and Publisher; L. H. ENSLOW, Vice Pres. and Editor; JOHN C. BLACK, Managing Editor; Associate Editors — J. R. BAYLIS, A. M. RAWN, H. A. FABER; H. J. CONWAY, Make-Up Editor; D. G. LEDGERWOOD, Advertising Editor.

Chicago Office, L. H. Lingnor, Rep., 330 S. Wells Street. Cleveland Office, B. C. Brumm, Mg'r., 2025 Lakeland Avenue, Lakewood, Ohio. New York Office, J. M. Angell, Jr., Eastern Mg'r., 155 East 44th Street. San Francisco Office, Don Harway, Rep., 420 Market Street.

Un-accounted-for-water Reduced 10% to 15%

Field-testing a large meter in se

"WATERWORKS OPERATORS, as a whole, recognize the importance of reducing or minimizing the waste of water; and most of us have set up a systematic program of leak elimination with a view of reducing our un-accounted-for-water; but some of us have been prone to disregard the importance of carefully checking, periodically, our large meters above one-inch in size.

If a leak of very small magnitude is reported or detected, the maintenance crew is put to work at once repairing it; while on the other hand, a large industrial meter, through which a very large volume of water is consumed, might be allowed to run an under-registration of fifteen percent to twenty percent for quite a long period of time. From a standpoint of practical operation, what difference is there between a leak on a main in the street and the waste of water leaking through a consumer's meter from which no revenue is derived?

The un-accounted-for-water in Nashville has been reduced some ten or fifteen percent in recent years; and the writer is of the opinion that this result is attributable, in a large measure, to the intensive program of testing and repairing our large meters in the two-inch, three-inch, four-inch and six-inch sizes."

Robert L. Lawrence

Superintendent & Chief Engineer

NASHVILLE, TENN. WATERWORKS DEPT.

More Revenue Through Better Testing Water Meters

WATER WORKS & SEWERAGE

VOL. 88, NO. 9 *A Gillette Publication* SEPTEMBER, 1941

THE METER MASTER

The Adjudicator of Many Water Works Problems

By D. R. TAYLOR
Plant Superintendent
ROANOKE, VIRGINIA

THE advent of the service meter recorder brought to the waterworks profession a most desirable and much needed piece of equipment. It provided the placater and the entrepreneur of public relations with indisputable and tangible facts, which he could substitute for many inadequate and empirical assumptions often relied upon in the use of former methods, to satiate those consumers who felt that the receipt of such an "unreasonable" bill was the height of something-or-other.

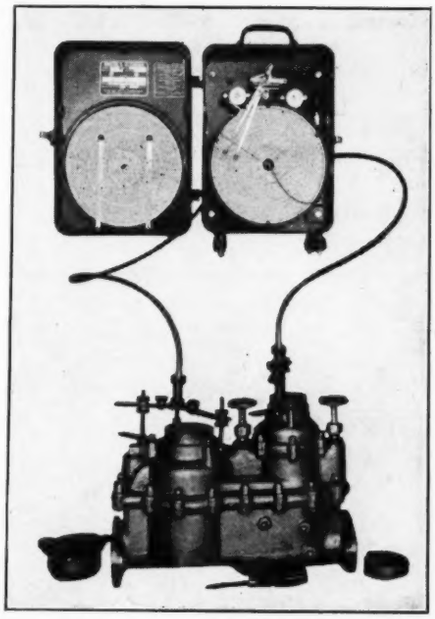
It has been said that one absorbs 80 per cent more knowledge through the eyes than through the ears, and a recorder will just about convince you and, better still, also the consumer, that this statement is true.

Such a recorder as the "Meter Master" can be quickly attached to any make of meter, and having two pens, it can be used to record simultaneously the consumption through both "sides" of a compound meter, or, for that matter, any two separate meters located near enough together for the attaching cables to reach both of them.

For the benefit of those who have not already secured such a recorder, we would like to briefly outline some of its advantages when used to investigate the causes of either normal or abnormal consumption of the domestic consumer.

We are of the opinion that consumers can be classified under three general headings. The first type are those that are quickly convinced and thereafter apologize for having even mentioned the matter, and, by way of reparation, copiously compliment the whole organization for its very efficient and courteous attention. The second type usually listens very seriously and attentively, asks a few pertinent questions, makes some slight formal gesture of a mild expression of gratitude and leaves you wondering if the interview has been really successful from a public relations standpoint. Then there is the third type. This type you will quickly recognize. He is the overbearing, insolent, supercilious bulldozer. He insists on engaging in disdainful innuendo, constantly interrupts, and is obviously too busy trying to think of more insulting and irrelevant questions to pay any serious attention to your explanation. Regardless of any degree of supererogation on your part, he is like the farmer who saw the circus acrobat "loop the loop" and turned to his wife and said, "That can't be done." This type usually leaves with a few vituperative epithets and venomous threats and hopes that you are sufficiently squelched. Of course, all three types eventually pay their bills (maybe sometimes being slightly influenced by visions of the man with the "iron cross") but you have really accomplished little, if anything, unless you have put your story across to their satisfaction (not yours).

"Doc" Taylor
No. 1 Adjudicator



The "G-Man"

This "G-Man of the Water Works Industry"

The "Meter Master" will make 99 per cent of *all* of these types eat right out of your hand. It presents all of the facts on one little chart, which we refer to as exhibit "A." This little picture transforms the evidence from the abstract to the concrete, and both conclusively and convincingly answers practically all of the questions. With this information of water use history in the home, conferences with consumers cease to be two-hour arguments and become short, interesting, pleasant discussions. With a little practice, one can tell any consumer what time he arose, when the meals were prepared and served in his home, how often the commode was flushed and how often the valve hung and had to be jiggled during the day; how

much water was required for the family wash on Monday, or was required to drain the cellar with a water-operated siphon, or was required to sprinkle the lawn or wash the car; at what rate his leaking spigot was wasting water, or the total consumption for the day or any part of it; what time his son came in the night before, and many other facts that astound the customer.

This instrument is, of course, just as useful in checking consumption through larger commercial and industrial meters and, in addition to all of these uses, it is also indispensable in determining the proper size and type of meter for the large consumer. As an illustration, we have a customer (a large office building) that is served by a four-inch compound meter. This customer complained about an increase in his bill for the month of March and our "G-Man" was brought into the case. The "Meter Master" record revealed that the average rate of consumption through this meter for eight hours every day from late Fall until early Spring was exactly at the bottom of the change over point (17 g.p.m.), causing the main valve to barely raise off of its seat, allowing an indeterminate quantity of water to pass through the meter unregistered. We could not install a smaller meter because the consumer had fire hose connected on each floor and insisted on a minimum of four-inch for use in the event of a conflagration. Furthermore, during the summer months, the operation of the water-cooled air-conditioning systems in this building caused a material increase in consumption and correct registration prevailed.

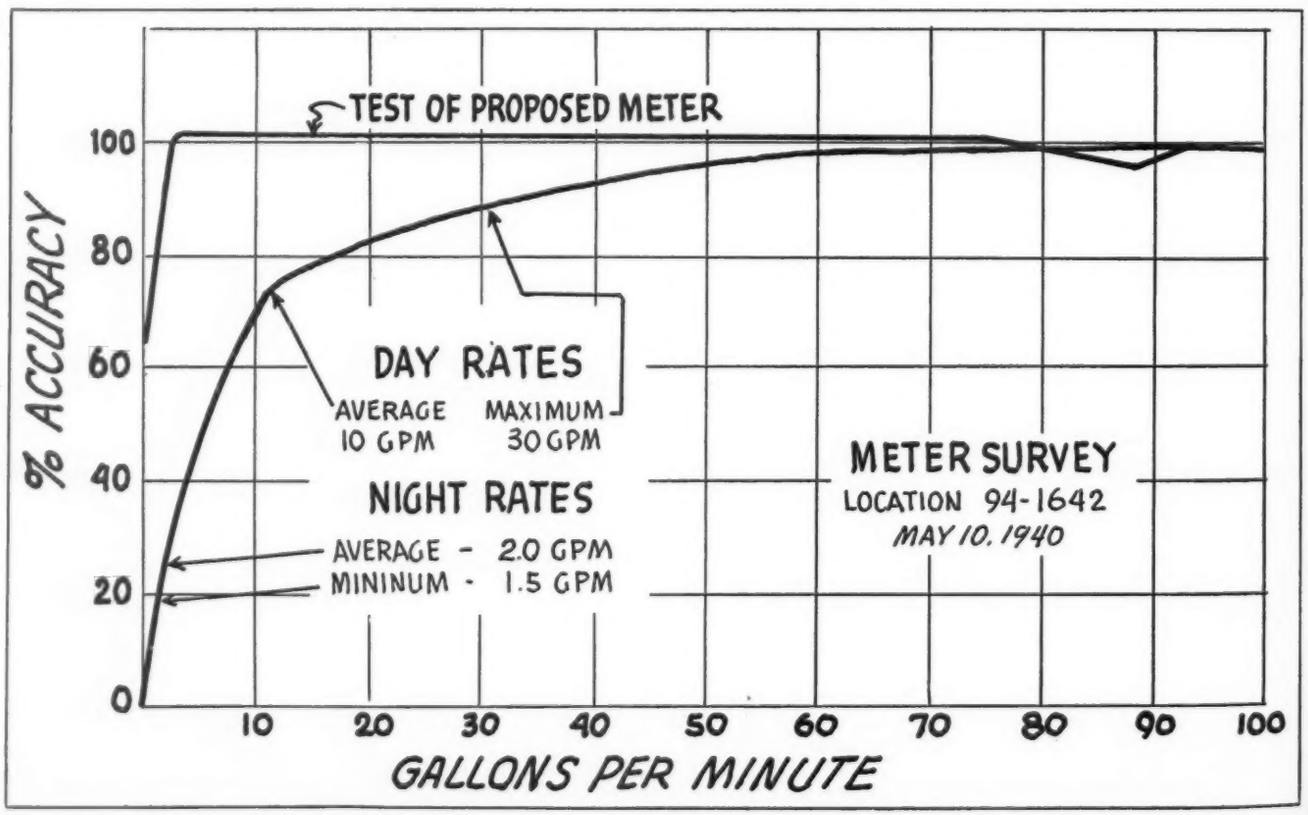
A Remedy for Off-Season Duty of a Compound

To remedy the situation, we installed, at small cost, a one-inch meter on a one-inch by-pass around this meter. We leave this by-pass open during the winter and the small auxiliary meter carries a part of the load (8 g.p.m.) accurately; the small side of the compound meter carries the remainder of the load (9 g.p.m.) accurately; the main valve remains on its seat; all of which results in an increase of about $84 in the annual revenue from this meter. From the middle of May to the last of September, while the air-conditioning systems are in operation, we cut off the by-pass, because during that time the rate of consumption is great enough to cause the compound meter to function properly. This consumer was not originally so much worried about the quantity of water used as he was concerning the accuracy of the meter. During the entire investigation, which included the testing of the service meter in place, he followed every detail, and now that he is convinced that he is not paying for any more water than he is getting, he is a satisfied customer.

In another instance, we are serving a large building which has sleeping quarters, showers, and a swimming pool. The meter is an old three-inch velocity type. With a total average monthly consumption of 217,166 gallons, the "Meter Master" shows that 91 per cent of this water is used during the day at an average rate of 10.5 g.p.m., and 9 per cent at night at an average rate of 2 g.p.m. In this case the consumer insists on a three-inch meter, which is needed once a week for filling the swimming pool. A field test of this old meter, as shown by the accompanying graph, shows that its accuracy of registration is only 23 per cent at 2 g.p.m. and 73 per cent at 10.5 g.p.m. A major overhauling might bring its accuracy up to some extent, but not anywhere near a point with which we would be satisfied.

Curve of Test of Present and Proposed Meters

The proper meter in this case would be a three-inch compound type;



The "Meter Master" Record Brought About This Field Test.

(Result—a pick up of roughly $180 more revenue annually through finding out how.)

however, we have a three-inch Protectus meter already in stock which, in this particular instance, is also well suited for the existing conditions and which we intend to install. The small side will take care of all normal consumption, and the large side will take care of the filling of the swimming pool once a week. The estimate of the increase in revenue, which is sufficient to justify the expense of the change, is calculated as follows:

	Gallons
Present monthly registration	217,166
91 per cent at 73 per cent registration	197,621
9 per cent at 23 per cent registration	19,545

Therefore, the actual consumption is probably

$$\frac{197{,}621 \times 100}{73} = 270{,}700 \text{ gallons}$$

$$\frac{19{,}545 \times 98}{23} = 84{,}900 \text{ gallons}$$

Total	355,600 gallons
Present average monthly bill	$ 41.46
Probable average monthly bill	56.85
Average monthly increase	15.39
Average annual increase	184.68

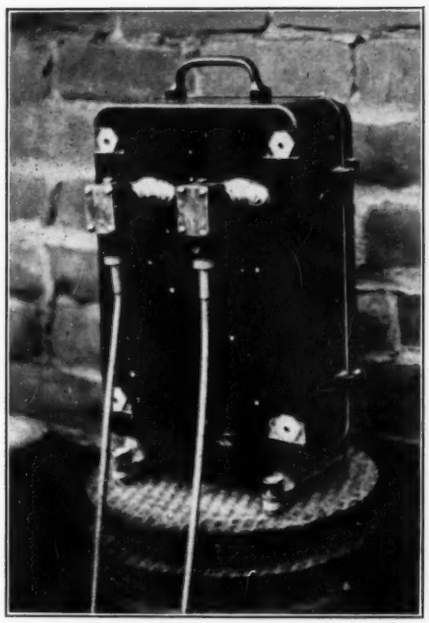
In another instance, as the result of a "Meter Master" survey, we have substituted a four-inch compound meter for dual service consisting of a four-inch velocity type meter and a two-inch compound. The resulting annual increase in revenue is $140.

At still another locatoin, a change from a two-inch velocity type meter to a two-inch disc type will give us a revenue boost of $40 per year.

Checking "Suspicious" Cases

From 175 meter installations of sizes from two-inch to eight-inch we have selected 75 "suspicious" cases which we felt should be checked with the "Meter Master." Of this number, we have investigated 35, obtaining from one to as many as six recordings at each location. This has resulted in proposed changes at four locations, three of which have been attended to and which will produce a total annual increase in revenue of approximately $450. Forty more are to be investigated, and we will be very much surprised if we do not pick up some extra revenue by making proper changes at some of these locations.

Our experience has convinced us that a well-planned, comprehensive survey of large meters is a much better plan than a desultory check and will pay attractive dividends not only with increased revenue but with the satisfaction and security of knowing that your metering equipment is proper and correct.



Conversion Gears

Attached to the cables at the rear of the instrument, recordings of cubic feet become recordings of gallons instead. For the benefit of customers, to whom cubic feet means so little, this change of recordings is made.

Other Uses for This Instrument

This instrument also has other uses. It can be used for making waste or leak surveys in territories with night rates low enough to be segregated and served through a two-inch meter inserted in fire hose between two fire hydrants.

The conditions of flow and head for which centrifugal pumps are purchased are often continually changing due to obvious causes, and for this reason these installations should be tested at least once a year to ascertain if a change of the impeller (or possibly the entire pump) is necessary to maintain the best efficiency. For such small installations, especially booster pumps which do not have station meters, a velocity type meter either permanently or temporarily installed on the discharge of such pumps and the "Meter Master" are admirably suited for such tests. In many cases the same meter can be used to test several pumps. In one instance where such a test brought about the replacement of the pump, the savings in power paid for the new pump within two years.

Determining Demands of Sub-divisions

If small towns or subdivisions are served through master meters, as is the case with us, this recorder affords an excellent means for the determination of, among other things, leakage as well as domestic demands and rates, all of which are interesting and often surprising. As an example, one of our (above the average) residential sections consisting of fifty-three homes has an average daliy maximum rate of 12.2 g.p.m., a minimum rate of 1.66 g.p.m. (this includes main as well as plumbing leakage and is hard to believe), an average rate of 7.9 g.p.m., and an average daily consumption of 215 gallons per house per day.

For another average subdivision of 460 houses the maximum rate is 71 g.p.m., the minimum is 12.5 g.p.m. (including main and plumbing leakage), the average is 47 g.p.m. and 147 gallons per house per day.

For a small town with a population of approximately 4,000, the maximum rate is only 150 g.p.m., the minimum is 41 g.p.m. (only 50 per cent metered), the average is 103 g.p.m., and the per capita consumption is 50 gallons per day.

It is almost as hard to look at a subdivision or a small town and tell how much water it will use as it is to look at a frog and tell how far he will jump. We engineers spend a great portion of our lives compiling *average* figures but rarely ever find an average condition.

Making the C-Man More Human

We had felt for some time that there was a need for some means of converting the "Meter Master's" records from cubic feet to gallons (we use cubic foot dials) so that those of our employes who interpret the record for a consumer could explain directly from the chart in terms of gallons, both rates and quantities, without having to calculate them before or during the interview. A total of 40¾ cubic feet, or a rate of one-tenth of a cubic foot per minute, means absolutely nothing to the average consumer, but if you tell him that he has used 305 gallons of water per day or that his commode is leaking at the rate of two quartes per minute, you are using language that he can instantly comprehend. While we definitely prefer cubic foot dials, we also prefer gallon nomenclature when interviewing customers, because there are some consumers who seem to think that there is some form of subterfuge or finesse in the use of cubic foot measurement in the sale of water.

Due to these reasons, we asked the manufacturers if they could make for us two reduction gears with a ratio of 1 to .75, and they readily

complied with our request. The manner of connecting these reducers on the back of the instrument case is shown in the photograph.

These accessories, which can be obtained at a nominal cost, have proven to be convenient and effective. For general plant surveys, studies and investigations, the requests for which originate within the department, their use is dependent upon the judgment and wishes of the employe in charge of the job in question. The instrument is equipped with a twenty-four-six hour clock which can be changed from one to the other by simply turning a shaft, and charts for each can be obtained. Oftentimes, a twenty-four hour record will suggest a six or twelve-hour record for closer observation, within finer or more accurate limits, for some fractional part of the day. The six-hour chart can be easily read to within thirty seconds, and a twelve-hour record, which can be read with the same precision, can be obtained by allowing the six-hour chart to revolve twice.

A Handy Block and Tackle Chart*

Here is a chart that will be found useful for determining safe loads and proper loads in connection with ordinary block and tackle.

By laying a straight edge across the chart, as indicated by the dotted line, the pull necessary to lift any weight up to 200,000 pounds is immediately given in column B.

This chart takes into account the friction of the ropes and pulleys, which is less for a smaller number of ropes, although the pull on the lead line is decreased if a larger number of ropes are employed.

For example, what pull on the lead line is required to lift 20,000 pounds with five ropes?

Solution: The graduation corresponding to 5 in column A is connected by a straight line with that corresponding to 20,000 pounds in Column C. The straight line intersects column B at approximately 4,700, which is the pull required.

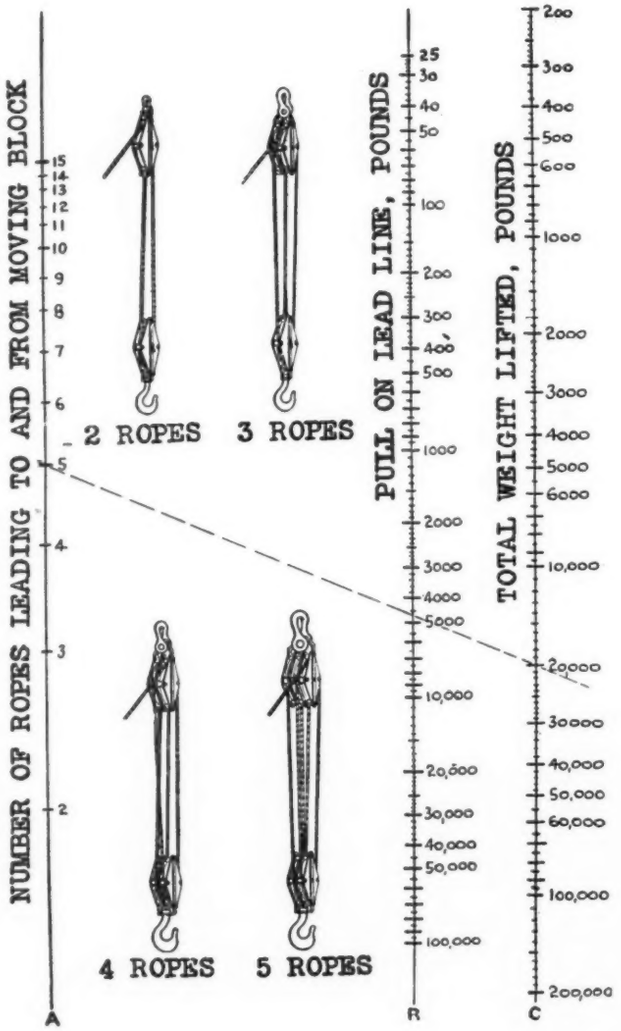
The number of ropes supporting the load and used in column A is determined by counting the ropes leading to and from the moving block as illustrated by the sketches.

In arriving at the stress in the lead line, the common practice is to divide the weight of the load by the number of ropes supporting it, but this is not correct as it does not take into account the friction of the blocks or the rigidity and internal friction of the rope. The maximum stress when hoisting occurs in the lead line, since this besides taking a proportion of load on a single supporting rope also takes the accumulated friction of the blocks and rope in all the other parts of the tackle.

If, for example, a "seven rope" hoist is employed for raising a load of 35,000 pounds, according to the usual practice the stress in the lead line would be computed as 5,000 pounds, assuming that all parts pulled equally. This stress occurs, however, only in the becket line. The maximum stress is 6,325 pounds as determined by test. The chart gives that figure very closely, as will be observed.

Although this chart is based on figures that were determined for wire rope tackle, it is also applicable to ordinary manila rope.

It must be remembered, when buying a rope for use in a block and tackle, that the rope must be strong enough to resist the "maximum" pull, which is the pull in the *lead* line.



*Contributed by W. F. Schaphorst, M. E., Newark, N. J.

OUR METER ROOM

Designed and Equipped for the Needs of a Department With 3200 Metered Services at Cost of $1500

By ROGER W. ESTY
Superintendent
WATER AND SEWER BOARD
DANVERS, MASS.

THE Town of Danvers is situated in the northeastern part of Massachusetts, has a population of 15,000, and is a farming and industrial community, with considerable historical background.

The water system, started back in 1876 with some twenty miles of pipe and about 500 services, today covers 67 miles and has 3200 metered services. Our consumption started off with about 120,000,000 gallons per year and increased to an annual consumption of 550,000,000 gallons during the 1920's. Metering, which was begun in 1922, has caused water waste and total consumption to drop some every year until now Danvers uses only about 360,000,000 gallons annually.

For years, while our consumption was decreasing and our metering was increasing, our revenue kept increasing, until it became permissible to reduce our service charge 20 per cent. Later the meter rate was cut 25 per cent, and it will be necessary in the very near future to again reduce our rates.

All of this is the result of planned metering. Up to two years ago we had no meter testing room in which to test, store, and maintain our meters. Most of our meters—70 per cent—have only been in about five years, and we felt it was becoming necessary to build and equip a modern up to date testing room to properly maintain them.

The Author

Our Compact New Meter Shop

Well, what is different with our testing room than what you may have? It may be different in one respect; and that is, we are starting off with everything new. Three years ago we were planning for a new shop building but it just didn't materialize, so the Board decided that they would build and equip an up to the minute meter-room within our present shop building. For the purpose $1500 was voted to equip it.

Outside of our commercial meters we only had about 1,000 meters, from 1922 to 1934. Then we started to install a few hundred each year until we had 3200 meters in service by 1938.

The pictures accompanying this article illustrate our present set up which we feel meets our needs in a satisfactory and efficient manner.

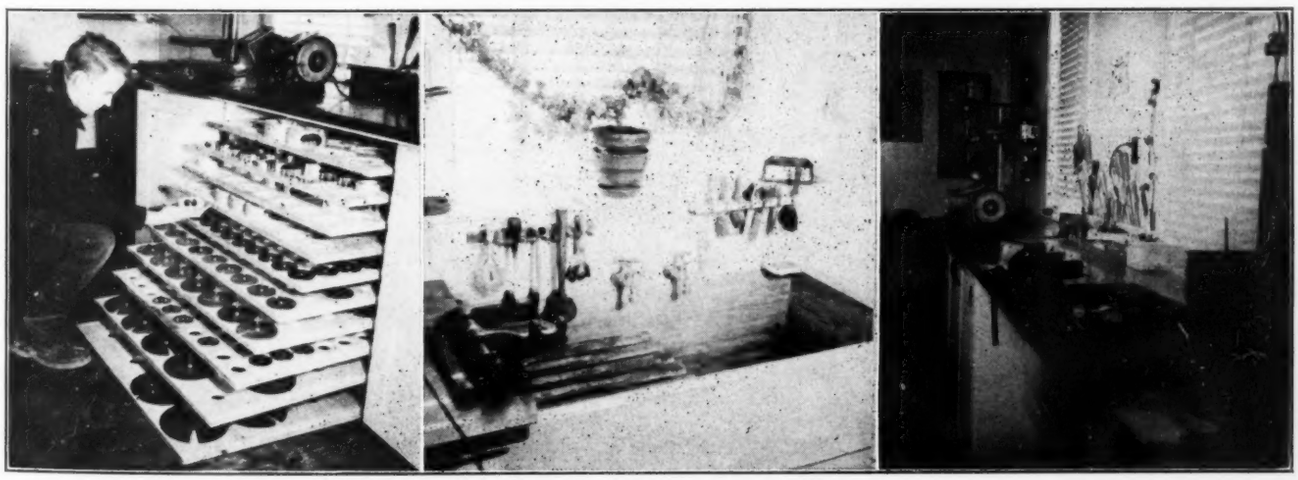
The room is 21 feet 3 inches long by 11 feet wide with Homasote wallboard walls, stained hardwood floor, three windows equipped with venetian blinds and two doors. So, first of all, it is light and airy. For artificial light it is lighted by fluorescent lights.

Modern Equipment

We installed a three meter Ford testing machine and Ford's Testerate device, which regulates the testing flow in gallons per minute, a 10 cubic foot tank and 1 cubic foot tank.

In the corner of the room, between the meter testing machine and bench, we constructed a wooden washing sink which is 3 feet 4 inches by 1 foot 8 inches by 36 inches high.

Our bench is 12 feet 4 inches and 2 feet 5 inches wide and is 3 feet high. It is constructed out of oak,

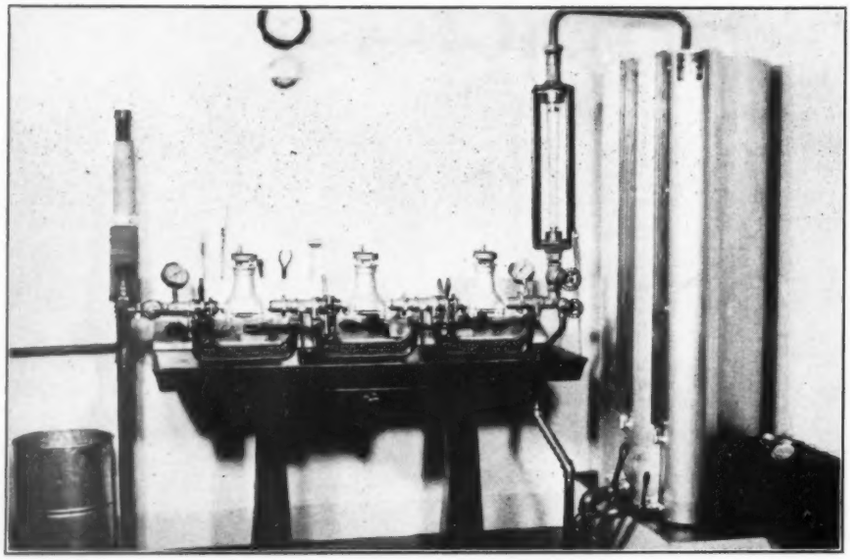


Views of the Danvers Meter Shop

Convenient method of storing meter parts. We call it our "baker's wagon," after which it was patterned.

The wash-zinc in a corner; meter holder for dismantling; cleaning gadgets and handy roll of paper towels. The ivy adds a touch.

Work bench with record file and desk in corner. Portable drill press, grinding and brushing machine—and plenty of tools and light.



Our Three Unit Ford Testing Machine

Equipped with flow indicating "Testerate" unit, above, discharging into calibrated 10 cu. ft. and 1 cu. ft measuring tanks. This set up is a "honey."

and is covered with a steel top. It has a meter-holder on the end over the sink, where the meters are taken apart, and a small vise is located near the same end. At the other end is a portable drill press and a portable grinding and brushing machine.

Under the bench top near the sink is a drawer for the every day tools. Then an empty space to sit before, so your legs can go comfortably under the bench. Under this section is our air line hose coming in from the garage. We find the air hose a highly important and useful part of meter shop equipment, because it is very essential to have air to properly clean and dry out the disc chamber for proper fitting. Also air is useful for operating a meter for any purpose, particularly the "running in" of discs.

Storage Shelves

Then we have what we call our "bakers wagon shelf-storage," a series of shelves, grooved and slotted to hold gear trains, registers, covers, discs, and chambers. This is the finest method of storage that I have been able to find or devise. With this scheme many supplies can be stored in a very small space.

The next section is made up of three drawers for miscellaneous storage, equipment, and tools.

Record File Handy in Shop

At the end of the bench is sufficient space for a steel desk which contains a card file of all of the meters. These record cards show a complete meter history, as to where and when installed, when the meter has been taken out to be tested; also the results of the tests, with a list of all material used in making changes or repairs. This desk also serves as a place to do the necessary book work by the meter-man and a place to keep his test books, etc.

Along the other side of the room are three sets of steel shelving which is ample storage for all active meters. That is, those brought back from summer service for winter storage, and from houses where service has been discontinued for an indefinite period. There are seven shelves each, supplying space to store 250 meters.

We read all of our meters by districts, as we have the town divided up into A, B and C sections, and so we have assigned Section 1 for meters in District A, and Sections 2 and 3 for Districts B and C.

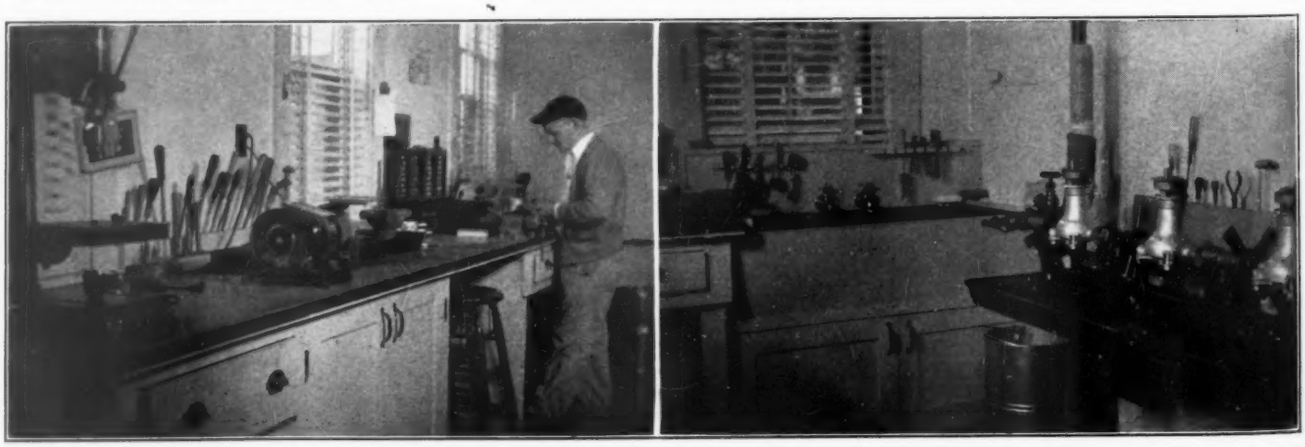
All inactive meters are stored away in another room which leaves this room entirely for active material, which plan makes for better "housekeeping."

At the end of the storage racks we have a cabinet of ten drawers, all divided up into small compartments, which holds the small parts of the registers, gear trains, discs, etc. Over our bench we have three sets of very small drawers which hold several sizes of change gears and some parts of the discs and gear trains.

This description I feel will give a pretty good idea of what we feel a well fitted meter testing room should have, to test and maintain 3,000 meters. The only difference that I can see between what we have and a city having say 7500 meters would be: first, a testing machine of greater capacity; second, a little larger bench; and third, additional storage facilities.

Design to Save Steps and Loss Motion

Make your room cozy, don't make it too barny. Arrange the testing machine, washing basin, and repair bench close together. It saves time and steps, steps—and, this is very important. I have seen meter rooms in which the meter man spends far too



Two More Views

Looking "aft" down the bench. A close look will reveal the highly useful air hose at the central working space.

Another look at the "wet-end" of the room. Wash-sink, with storage beneath, and the Ford testing machine.

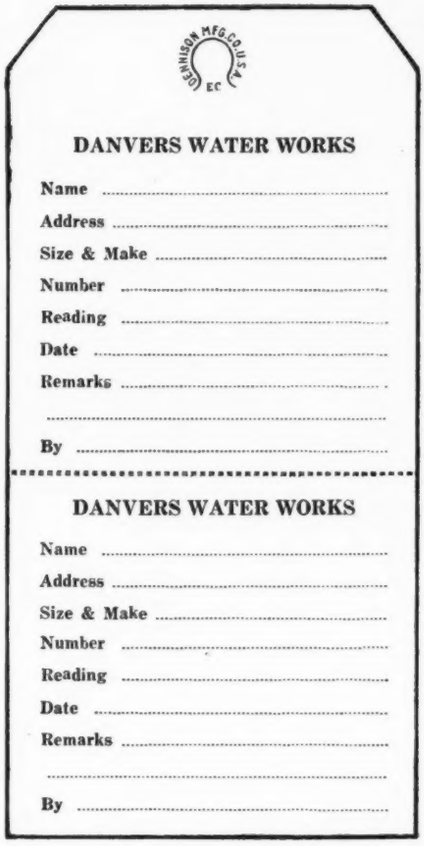
much of his time walking back and forth, and back and forth, from one operation to another.

Our meter room is the result of my observations in a great many other water plants, and from the many helpful suggestions we have received from superintendents and meter-men who actually do the testing. I am indeed very grateful to them, and I extend an invitation to all water works men to visit our meter room, for it may offer some thought or suggestions toward even a better set-up than we have here at Danvers.

In my travels, interviews and correspondence there seems to be no fixed standard procedure in testing; and, furthermore, no one in authority (like a sealer of weights and measures), ever checks up to see whether or not the meter has been properly and thoroughly tested to the mutual interests of the customer and the utility.

Samuel F. Newkirk of Elizabeth, New Jersey, is chairman of the Joint Meter Specification Committee for the A.W.W.A. and N.E.W.W.A., and his committee has essentially completed a new set of specifications that are more rigid in certain directions, and more flexible in others, than those of the past.

In the August issue of WATER WORKS AND SEWERAGE there is an article on "Water Meter Maintenance Practice" that was recently read at the A.W.W.A. Toronto convention, which is very timely. It is the result of a survey by A. P. Kuranz, Superintendent of the Waukesha, Wis., Water Department, made to secure a cross-section picture of meter maintenance policies and practices in this country.



Meter Record Card and Stub

Why Not "Standards of Testing Procedure"?

The thought has occurred to this writer—why not have the present committee also develop "Standards of Meter Testing Practice," to serve as a pattern in equipping meter-test shops of various sizes, and a guide in the proper and most dependable procedures and operations in actual routine testing practice? To the writer, at the time of designing and equipping the Danvers meter-room, and to many others contemplating new meter shops or revamping existing ones, such a guide would prove of high value and usefulness. It will also go far toward bringing standardization and better practices into the important field of metering, where there appears to be room for much improvement and a real need for standardization.

DANVERS WATER WORKS

Make
Number | Order No.
Reading B. T. | Acct. No.
Reading A. T. | Tap No.
Date Tested

Number of Cubic Feet	Discharge G. P. M.	PRESSURE Inlet	PRESSURE Outlet	%	REMARKS

194 Inspector

Meter Test Record Form

A SEWERAGE TREATMENT KINK

In Which Necessity Proved the Mother of Invention

Contributed by
REGINALD L. BLANKENSHIP
TOWN-MANAGER OF ORANGE, VA.

Mr. Blankenship has by letter told us of what he terms a "Krude Kink" in sewage treatment which he believes, and we agree, may prove very helpful to others who find themselves in the same predicament in the matter of getting rid of sludge during winter.

We all know the story of sludge troubles in small plants, where if you draw out too much sludge from the digestion compartment in the late fall you have little digestion during winter, and foaming in the spring. If you don't draw out enough sludge in late fall you have a full digestion compartment before spring and nowhere to put the sludge. So often it's a case, of "be damned if you do, and be damned if you don't." The expedient successfully resorted to by Mr. Blankenship, in getting rid of sludge in winter, is worthy of note. He explains the scheme as follows:

> "We have a small sewage plant with uncovered Imhoff Tank and drying beds, and it has been our practice to drain sludge during the summer months and let it go over the winter months. This, as you will know, causes trouble in the early spring when you have ten thousand other things to do without having to nurse an unruly tank. Last winter and this, because of necessity, we drained the tank all through the year. By picking cold days to throw the sludge cake out of the bed, while frozen, we have found it just as easy to handle afterward as is the "sun-kist-kake" that we take off in the summer.
>
> I mention this somewhat "Krude-Kink" because it has proved to be one of the most valuable pieces of sewage matter that we have struck, and I hope that some other operator may profit thereby."

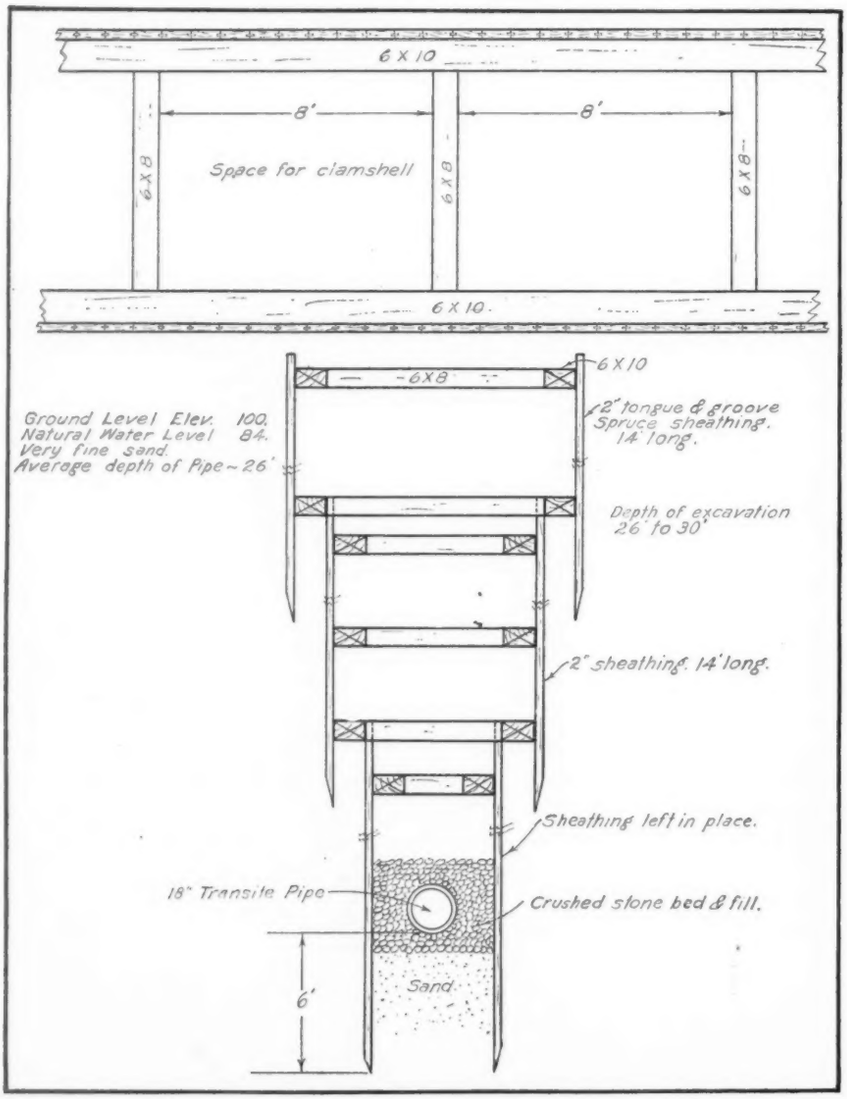
TRANSITE PIPE USED IN DEEP AND DIFFICULT SEWER JOB

By HORACE J. COOK
Engineer and Superintendent
WATER AND SEWERAGE DISTRICT
AUBURN, MAINE

IN THE spring of 1937, sewage was found to be backing into the basements of a large number of residences in Brunswick, Maine, the home of Bowdoin College. It was, in fact, the area occupied by this institution which was affected.

Upon investigation, it appeared that the 12-inch vitrified clay pipe sewer was crushed and entirely plugged. Attempts were being made to remedy the condition by relaying this with a 12-inch cast iron pipe.

The Author



Details of Sheeting in Fine Sand Sewer Excavation to 26 ft. Depth

As the water standing in the trench was considerably above this pipe, it was evident that either this cast iron pipe was plugged or that the grade was such that the water could not flow through it.

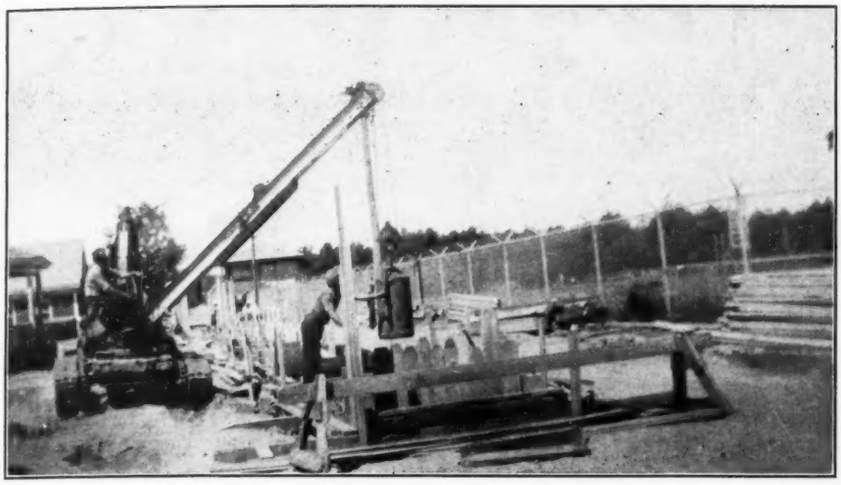
Further investigation showed that the 12-inch pipe was too small for the area served. It was found also that the 12-inch iron sewer was out of line horizontally and vertically. Later a hump in the pipe of 3 feet was discovered, which gave an adequate reason for the water standing in the ditch.

When holes were driven to check conditions, it was learned that the grade of the original sewer was from 24 to 28 feet below the surface of the street. The soil was a very fine sand. At the depth of 16 feet water was encountered, which meant that the entire trench must be tightly sheeted to prevent the flow of quicksand. It was also known that the joints in the iron pipe were not tight and that the water and fine sand were filtering into the sewer.

It was decided to lay an entirely new 18-inch line from Pine Street to Harpswell Street, along Bowker Street. An 18-inch pipe of the type used on a 3 per cent grade, will carry three times as much water as a 12-inch clay pipe. The grade and depth of the sewer had been determined by the original builders years ago. The sewage was delivered, at a certain depth, at the junction of Harpswell and Bowker Streets, with its outfall, at a certain depth, at the junction of Pine and Bowker Streets. A straight line between these points was the only grade possible. This gave only a drop of 4 inches in 100 feet.

"Transite" Pipe Used

The pipe chosen for the job was "transite" pipe; a product of the Johns-Manville Company. This pipe is being used increasingly in the waterworks field for distributing water under pressure. As it is constructed of cement and asbestos it

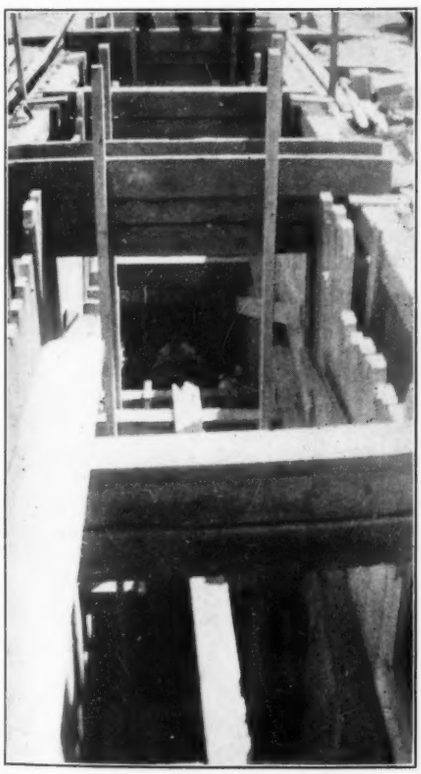


Bucket Used in Deep Excavation Going to 26 ft. Below Street Level

does not lose any carrying capacity due to incrustation, and has a very high crushing strength. The trench was entirely too deep for the use of vitrified clay pipe unless it was encased in concrete. The Johns-Manville Company guaranteed that this pipe would stand the pressure, and that asphaltic joints made according to their instructions would not leak.

Sheeting Method

The accompanying sketch and pictures show the layout of the sheeting. Spruce timbers 6 x 10 inches in size, placed not over four feet center to center acted as rangers. The braces were 6 x 8 inches with eight feet clearance for a chance for the clamshell bucket. Three sets of sheeting were used, the lower being left in place.



Sheeting and Bracing
(For details see text)

It was found impractical to use the sewer already laid to drain away the water in the trench, as the men working in the trench would stir up the fine sand and the water would carry it into the finished section. Here the grade was so flat that the sand would settle and clog the pipe. It was necessary to pump the water out of the trench into a settling box where the sand was removed. As four cubic yards of sand per day was removed in this manner, it would have been but a short time before the new sewer would have filled, if this water and sand had been allowed to enter it.

In the construction of this new sewer, several difficulties were encountered which were lacking in the first work. The drainage and sewage of all the great area above was being emptied into the trench continuously. The old cribbing used in the original construction had been left in place to a great extent. The old pipe, in many cases encased in concrete, had to be broken up with air hammers and removed. There were more buildings to protect, especially the Bowdoin College grandstand. All these features made additional costs which were lacking in the first job. The use of a rock fill under the pipe to give a better foundation than the quicksand, and to provide subdrainage, was another added cost.

Costs

In checking the costs of the original sewer in 1903, it was found that the cost to the town was practically $18.00 per foot. The first contractor had financial difficulties, and it was finished by another, so the real cost was never known. The repairs since that time had totaled $15.00 per foot. As labor and materials at that time were about forty percent of today's prices, the present cost, in line with the 1903 prices, would be about $45.00. A a matter of fact, the expense was $32.00 per foot, or less than the original cost, plus the repairs. Mr. Everett Beedy of Auburn, Maine, was the Superintendent in charge of the work, and it is to him that the credit should be given for the efficient way in which the work was handled.

The new transite pipe sewer has been in place now over three years. To date there has been no indication of infiltration of sand or water. Neither has there been any settling in the streets. [*The author served as consultant on the project.—Ed.*]

The 18" Transite Pipe in Place

I AM A COG IN A MACHINE

By
HUDSON NIX

Who is Mr. Nix? He is a young man who makes his living as a shift operator in the water treatment plant of the Tubize Chattilon Corporation at Rome, Ga.

In WATER WORKS AND SEWERAGE *for October, 1940, Mr. Nix appeared as a contributor for the first time. His article, "Are There Any Fifth Columnists in Your Water Plant?" took the form of a timely and pointed editorial of excellence. Not long afterward the present short article by Operator-Author Nix appeared in "This Week Magazine." We liked it well enough to seek permission to reprint it, and here it is.*

As we read Mr. Nix's "I Am a Cog," the thought came to us just how much happier we would be if America had more such "cogs"—more Nixs—instead of the sort who find it opportune to call strikes against America at such a time as this. Naturally, there is no need for preaching this sermon to water and sewage works operators, but Mr. Nix's short article seemed to carry such a timely bit of philosophy, and is so well written, we thought that other plant operators would enjoy reading it.—L. H. E.

"JUST a cog in a machine, replaceable at a moment's notice."

I am a shift worker in a huge industrial plant, and this is the way a famous writer has defined my position in life. The definition is correct, yet I take great pride in my job, because small as it is, it is vital to a great business—the business of life and progress.

For eight hours each day I am the human cog responsible for the operation of a number of pumps, motors and machines. They must be kept running to supply water to a rayon mill, which gives employment to more than two thousand other human cogs, including the resident plant manager and the president of the company in a Park Avenue office a thousand miles away. Each of us performs a job that is necessary in the operation of this one plant, which itself is merely a cog in the rayon industry of the country. In turn, the entire rayon industry is just a cog in the country's industry as a whole. And industry, like agriculture and government, is only a cog in the machine that is American democracy.

So I accept the famous writer's definition. I *am* a cog in a machine—but that doesn't mean for a moment that I can't be a definite individual as well. True, I work with clocklike regularity at a routine task for forty hours each week, but I have a hundred and twenty-eight hours in which to satisfy my human needs and desires. The radio, movies, sports, books and magazines, hobbies, the church and politics—all of these and many more provide outlets for my interests as an individual.

As a cog in a machine, I have distinguished company. It includes Henry Ford, Owen D. Young, the Du Ponts and countless other important men. And in other machines there are other human cogs carrying on the duties of President, governor, senator and judge; even the scientist, the philosopher and the artist are cogs in their special machines. As in my case, each of these can be replaced. If he could not be, then the machine would be crippled, progress would stop and democracy perish.

I AM particularly glad that I'm a cog in our industrial machine. Industry has its faults, of course, but it seems to me that its aim is the happiness of all of us. For the very growth of this machine depends upon its ability to bring more comforts and conveniences within the reach of more people every year. I am a cog in the machine that is the never-failing servant of humanity. The health, happiness and prosperity of all the people, taken together, is a measure of the success of this machine. And every time a family buys a new radio, a refrigerator, an automobile, or a cake of soap, that family enjoys the fruit of my labor. Just as I am benefited by the work of millions of other cogs every time I pick up the telephone, turn on water, push the electric light switch, or read my newspaper.

As a cog in a machine, I am a member of the noblest brotherhood on earth—the brotherhood that works to promote health and happiness for all the people and a stronger democracy for our country. Alone, one single cog seems insignificant, but judged by its contribution to the progress of the whole machine, its work is of great importance. And because each cog is so vital to the whole machine, progress demands that there must be a quick replacement whenever one stops doing its work properly. Knowing that I could be replaced at a moment's notice does not make me feel insignificant. Rather, I am heartened by the knowledge that another cog would carry on in my place or in the place of any other cog, whether it operates in industry or government. In no other way could I be sure of happiness and progress for my children.

Laborers, doctors, clerks, scientists, statesmen, soldiers, businessmen, mechanics, policemen and artists are all cogs in a machine—the machine that is run by all humanity. And, instead of being depressed, I am inspired by the famous writer's definition. I am proud of being a cog in a machine, because I realize that each cog plays an important part in the great machine that is America.

SLUDGE DISPOSAL AT SEA

Experiences and Costs During Three Years of Cargoing Sludges to Sea from Three New York City Treatment Plants

By NATHAN I. KASS
Engr. in Charge*
SEWAGE DISPOSAL OPERATIONS
NEW YORK CITY

WHEN the 180 M.G.D. Wards Island Sewage Treatment Plant, the first of New York City's modern treatment plants built, was placed in operation on October 16, 1937, ahead of schedule none of the three specially designed sludge vessels, then under construction, were ready for service. These vessels are described by Mr. Henry Liebman, Engineer of Design in the Department, in his companion paper which appears in this same issue. In view of this, no attempt will be made by the writer to describe the vessels, other than incidentally, and this paper will be confined to the operation and maintenance of these sludge vessels.

The Author

In the interim between starting plant operations and delivery of the first of the vessels it became necessary to make other arrangements for getting the sludge cargoed to sea. A contract was entered into with the Merritt, Chapman and Scott Corporation for transporting the sludge from Wards Island to a deep sea dumping site situated eight nautical miles East Southeast, magnetic, from Scotland Light-Ship. This is the same location used by the Passaic Valley Sewerage Commission for dumping its primary sludge since the fall of 1924, and the Elizabeth Valley Joint Meeting for a shorter period.

The contract price for the performance of this work was as follows:
$350 a day or part of day for the tank barge; $420 per round trip of the tugboat; and $50 additional charge for services rendered on Sundays or holidays.

The services of Merritt, Chapman and Scott continued from October 19, 1937, to January 18, 1938. During this period, 23 trips were made by the tank barge "Dykes" towed by an ocean-going tugboat.

The total quantity of sludge taken to sea in the 23 barge loads was about three million cubic feet, or 95,000 wet tons of sludge, having a dry solids content of approximately 6,100 tons. The cost of this removal amounted to about $35,000, making the cost per wet ton 37c and that per dry ton $5.84. These costs are to be compared with those reported later for sea disposal by our own sludge vessels, designed and built for the purpose.

*Department of Public Works, N. Y. City.

This paper and those by Messrs. Liebman, West, Van Duyne and Emerson, which follow it, were presented by the authors as a group of papers comprising a symposium on methods and practices in "The Disposal of Sewage Sludge at Sea."

This worthy symposium is representative of several such symposia, on specific sewage treatment topics, which have been arranged under the leadership of William Raisch, Consulting Engineer, as chairman of the Sanitation Group in the Am. Soc. of Mechanical Engineers, comprised of members in the N. Y.-N. J. Metropolitan Area.

We are privileged to present "Sludge Disposal at Sea," as we have other A.S.M.E. Sanitation Group papers in the past—a notable case being the group of papers revealing much that had never before been published on, "Grit—Its Separation, Washing and Disposal," which taken collectively constitute an authoritative reference work on this important phase of sewage treatment.

The present papers constitute the most valuable compendium of American experience, prevailing practices and costs of "Sludge Disposal by Dumping at Sea" that has yet been published.

City's Vessels Put in Operation

On January 17th, 1938, the sludge vessel "Wards Island" was delivered to the Wards Island Sewage Treatment Works. Her maiden trip with the first load of sludge from this plant took place on the following day. Soon thereafter the two sister ships, the M. V. "Tallmans Island" and the M. V. "Coney Island" were completed and turned over to the City. The "Tallmans Island" went to sea on her first trip on February 12, 1938, and the "Coney Island" made her maiden trip on May 25th. The dumping site for the three vessels was the same as that used previously by Merritt, Chapman and Scott Corporation.

Shortly after the operation of the City's sludge vessels had begun, numerous complaints were lodged with the Supervisor of New York Harbor against the dumping of sludge in the area designated for this purpose.

The objections raised were not based on any definite annoyance or inconvenience caused to communities located on nearby shores, but chiefly because of a popular aversion to sea dumping of any wastes originating from human habitation. This opposition was probably colored by seaboard dwellers' experiences during former years when dumping of garbage at sea was still the practice, and some of the floatables reached shore.

Because of these complaints, the Supervisor of the Harbor on February 25, 1938, ordered all municipal agencies involved to extend the distance to the dumping site from eight to twenty nautical miles East Southeast of Scotland Light Ship, commencing April 1st.

Concerned about the material increase in the cost of transporting the sludge in case the order would become effective, representatives of this Department, the Passaic Valley Sewerage Commission, and the Elizabeth Valley Joint Meeting, both of New Jersey, hastened to confer with the Harbor Supervisor and requested him to defer the execution of the order pending a thoroughgoing, scientific investigation to determine the effect of the dumping of sludge at the site in question. Because of the open-mindedness of the Supervisor of the Harbor towards this entire problem, he agreed to stay the order pending the findings of the investigation.

Investigation of Effects of Dumping

Accordingly, the representatives of these three groups, in cooperation with the Harbor Supervisor, started on May 2, 1938, a cooperative investigation which continued through May 7th. The investigation was conducted jointly by chemists, bacteriologists and engineers of the municipalities affected in the boat "Active," kindly loaned for this purpose by the Supervisor of the Harbor.

During the six days of the investigation a complete change of tide took place, and the wind blew from almost all points of the compass so that observations were made under nearly all normal conditions.

The general scheme of the investigation was as follows: At the center of the dumping area a motor boat was anchored, which served as a fixed mark, easily discernible in plotting and running the course between the sampling points. (See map.) The fixed point was designated as "A." With that as a center, four semicircles were drawn at distances of one, one and a half, two, and four miles, and marked "B," "C," "D," and "E." Intercepting the circles were five radii from point "A" with magnetic bearings of NE, N, NW, W, and

The N. Y. C. Sludge Navy

All three in port—the "Wards Island"; the "Tallmans Island"; the "Coney Island."

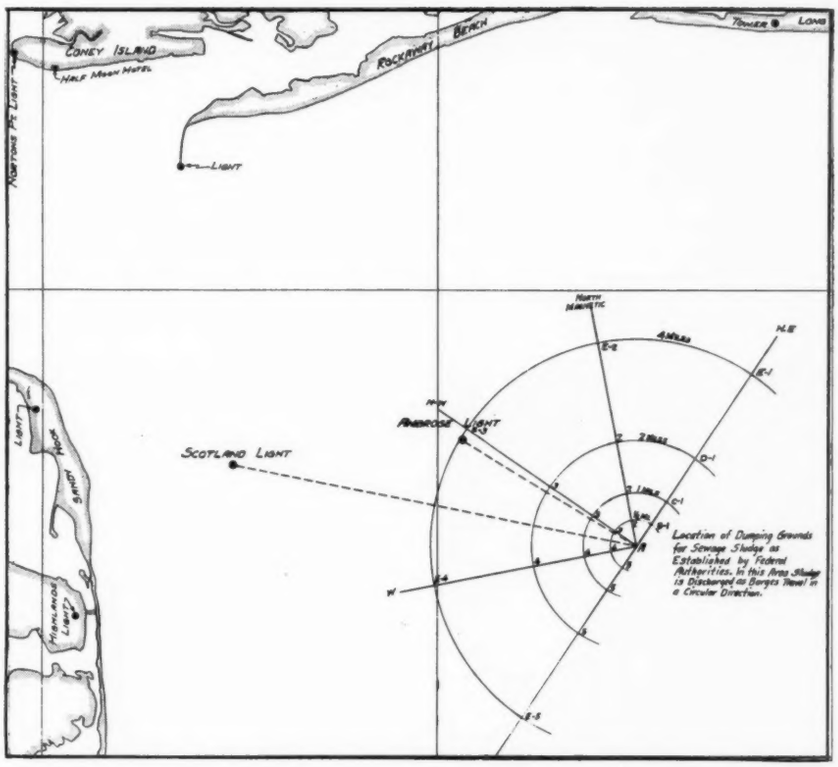
SW, numbered respectively from one to five. The intersections, identified by the letter of the circle and the number of the radius, together with point "A," formed 21 regular sampling points. The normal day's work, however, comprised 25 sets of samples because point "A" was visited once for each radius.

In addition to physical observations, affecting sight and smell, determinations of the dissolved oxygen, suspended solids, B. O. D., and bacterial content were made. A total of 140 sets of samples were taken and examined at the laboratory.

From close consideration of all data obtained, the following general conclusion was reached, which is being quoted herewith verbatim from the report covering the investigation: "The observations made during the investigation indicate that the most disagreeable effects from the dumping of sludge arise at the time of dumping and in the spot where the dumping is taking place. Sludge odors and floating material disappeared quickly and did not travel far. The water in the area which was under examination quickly regained a normal condition after each dumping, and the laboratory data supported these conclusions and demonstrated that the waters in the dumping area do not show signs of grease and persistent pollution."

As a result of the findings of this investigation, the dumping of sludge continued and still continues at the location designated as eight nautical miles East Southeast Magnetic from Scotland Light Ship. This dumping point is approximately twelve miles from the Long Island and New Jersey shores and is about thirty-four miles from the Wards Island Plant. The round trip, hence, is 68 miles, which is normally made in 6.5 hours, the actual dumping of the load taking only five to ten minutes.

Permits for each boat to dump the sludge at sea are obtained from the Supervisor of the Harbor twice a month upon the Department of Public Works submission of its applications. When the disposal of sludge from the Tallmans Island and Bowery Bay Plants was started, it was necessary to have the permits modified to include these two plants also.


CONEY ISLAND
HALF MOON HOTEL
ROCKAWAY BEACH
LIGHT
SCOTLAND LIGHT
SANDY HOOK
HIGHLANDS LIGHT
NORTH
AMBROSE LIGHT
Location of Dumping Grounds for Sewage Sludge as Established by Federal Authorities. In this Area Sludge is Discharged as Barges Travel in a Circular Direction.

Map showing location of deep sea sludge dumping grounds established by Federal authorities and location of sampling stations in study of pollution dispersion and extent of effects on adjacent areas.

Personnel of Operating Crews

The three vessels are operated by specially qualified men, a considerable number of changes having been made in the personnel since these vessels were placed in operation, both in the qualifications and number of men employed.

The Municipal Civil Service Commission was asked by the Department of Public Works to establish certain titles in conformity with crew requirements for the operation of these boats, as prescribed by the steamboat inspectors of the U. S. Department of Commerce. It also insisted upon certain additional requirements in the examinations given in connection with those titles because of the belief that the qualifications of the men for the sludge vessels were different from those manning ferry boats or vessels of commerce.

As a result of all negotiations and changes, by the end of 1940 our "sludge-navy" consisted of 51 men, representing a crew of 17 on each of the three ships. These crews are comprised of three deck officers—the captain, first and second mates; three engineers (marine)—chief, first and second assistants; three oilers (marine), six able-bodied seamen, one cook and one messman.

Because of the nature of the service and the area in which the boats are being navigated, reconciliation had to be made of the federal marine regulations, local harbor customs, and plant operating requirements for sludge disposal. In view of this, the setting up of working hours, leave schedules and the like, was very exacting. But all related matters were finally settled and normal conditions established.

Crews Live on Ships

Accommodations are provided on each ship for proper quartering of the personnel, and ample kitchen and refrigeration equipment was installed to facilitate the feeding of her crew.

About six months elapsed before a definite determination was made as to whether the City was obliged to feed the men on boats of the sludge vessel classification. Rules and regulations covering the subject did not seem to be clear when applied to this case, and opinions varied. Finally a decision was made calling for the lodging and feeding of the craft personnel. Since July 16, 1938, the city has been supplying the men with food, which is being prepared by a special cook and served by a messman assigned to each boat.

Because the food is obtained through the Bellevue Hospital at very low wholesale prices, it was and still is possible to feed the men at as low a rate as 50 cents

per man per day. The food supplied is adequate and of fine quality.

It may be of interest to note that about a year ago a compensation report was forwarded by one of the able-bodied seamen on an accident he suffered, which was described by him as "a deep cut and lacerations of right palm due to the breaking of a bone from a chicken leg." Thus a new occupational hazard has been added in the field of sewage treatment.

Each Is Radio and Odor Trap Equipped

No radio facilities were provided on the boats in their original design and construction. However, soon after they were placed in operation, the need for such equipment became obvious. The importance of being able to determine the whereabouts of the fog-bound vessels or learn quickly of any accident or mishap was realized by all concerned. Accordingly, a contract was let for the installation on each boat of 25 Watt capacity ship-to-ship and ship-to-shore radio equipment, which was completed in July, 1939.

Her Rakish Stern

Is presented by our "Tallmans Island" taking on cargo at the Bowery Bay plant.

Provision has been made for the trapping of splash-released odors from the sludge during the loading of the vessels and at times also while the cargo is being transported to sea. Gas vents with water-tight hoods have been built in the roof of the six sludge compartments of the vessels. Each vent is equipped with twelve large canisters filled with activated carbon, making a total of 72 absorber-canisters on each vessel.

Service Schedules

About once a year each boat is taken out of service for approximately three weeks, when it is drydocked for major repairs, overhauling, and painting. This work is performed under contract based on specifications prepared by the Design Section of the Bureau of Sewage Disposal. During the rest of the year, when normal conditions prevail, two of the three vessels are in active service, and the third is tied up at the dock of the Wards Island Plant for minor repairs and maintenance, such being made by the crew.

The two active boats serve three plants at present, namely, Wards Island, Bowery Bay, and Tallmans Island. From January, 1938, to December 4, 1939, the Wards Island was the only plant from which sludge was transported to sea. On the latter date the first load of raw sludge was taken from the Bowery Bay Plant and since then the trips from this location have continued at the rate of approximately one trip every eight days. The Tallmans Island Plant was first served by the sludge vessels on April 16, 1940, and removals from this plant have been carried on since then about twice a month. [Digested sludge-cake from the chemical precipitation plant at Coney Island has thus far been in demand for soil improvement by the Park Department and others.—Ed.]

Sludge Concentration Practice

Because the cost of disposal of sludge to sea is so greatly affected by the solids content of the material to be handled and transported, sludge concentration (especially of excess activated sludge) becomes a highly important factor in required facilities and costs in this method of sludge disposal.*

The degree to which sludge concentration should be carried on must be governed, first, by the cost of accomplishing such concentration, and second, by the fact that solids content may be increased to such a state as to make it difficult, if not impossible, to convey the sludge to the loading point by gravity or even by pumping.

Plain Subsidence

In the concentration of excess activated sludge at Wards Island, advantage is taken of the fact that the solids content increases with the detention period of the sludge in the final tanks. For this purpose, excess activated sludge from the entire plant is wasted only through four of the thirty-two final tanks, where the detention of the sludge is materially increased and its withdrawal carefully controlled. With this procedure, all sludge to be wasted is concentrated to 2% from about 0.5%. Even this simple expedient cuts the volume by 75%. Thereafter some further concentration of the excess sludge, and that of the primary sludge also, is effected through decantation from the sludge holding tanks in the sludge storage building at the plant dock. The average solids of the combined sludge disposed at sea from Wards Island in 1940 was 3.88%. During this period the primary sludge represented 36% by volume, or 59% on the basis of dry weight of total solids removed.

Thickening Aided by Chlorine

At Tallmans Island, concentration of the excess activated sludge is being accomplished by concentrating it in two relatively small thickening tanks constructed

[*This observation reaches further than the effects of sludge concentration on storage and transportation costs. We wonder if anyone has undertaken a study of the real worth of reducing the water input into sludge digesters for the several potential advantages—not the least being reduced digester capacity required, lower heat input demand, and less solids discharged in the form of efficiency disrupting supernatant liquor.—Ed.]

for the purpose. With the application of chlorine to the top water in the thickeners to subdue bio-activity in the sludge, a solids content of 3 to 4% can be obtained without difficulty from an original consistency of about 0.5%. Thickening at this plant is not continuous, however, because at certain periods operating conditions dictate the sending of the excess activated sludge to the head of the primary tanks, the combined sludges being digested in either event. Decantation of supernatant liquor from the sludge storage tanks supplies additional concentration of sludge before loading the vessels. The digested sludge removed from the Tallmans Island Plant in 1940 had an average solids content of 10.1%, even though it represents a digested mixture of activated and primary sludges.

At Bowery Bay only primary treatment is provided at present, pending the completion of construction for secondary treatment; therefore, primary sludge only has been taken to sea after decanting it in the sludge storage tanks. The solids content of the sludge removed from this plant during 1940 averaged about 12%.

Sludge Storage Tanks

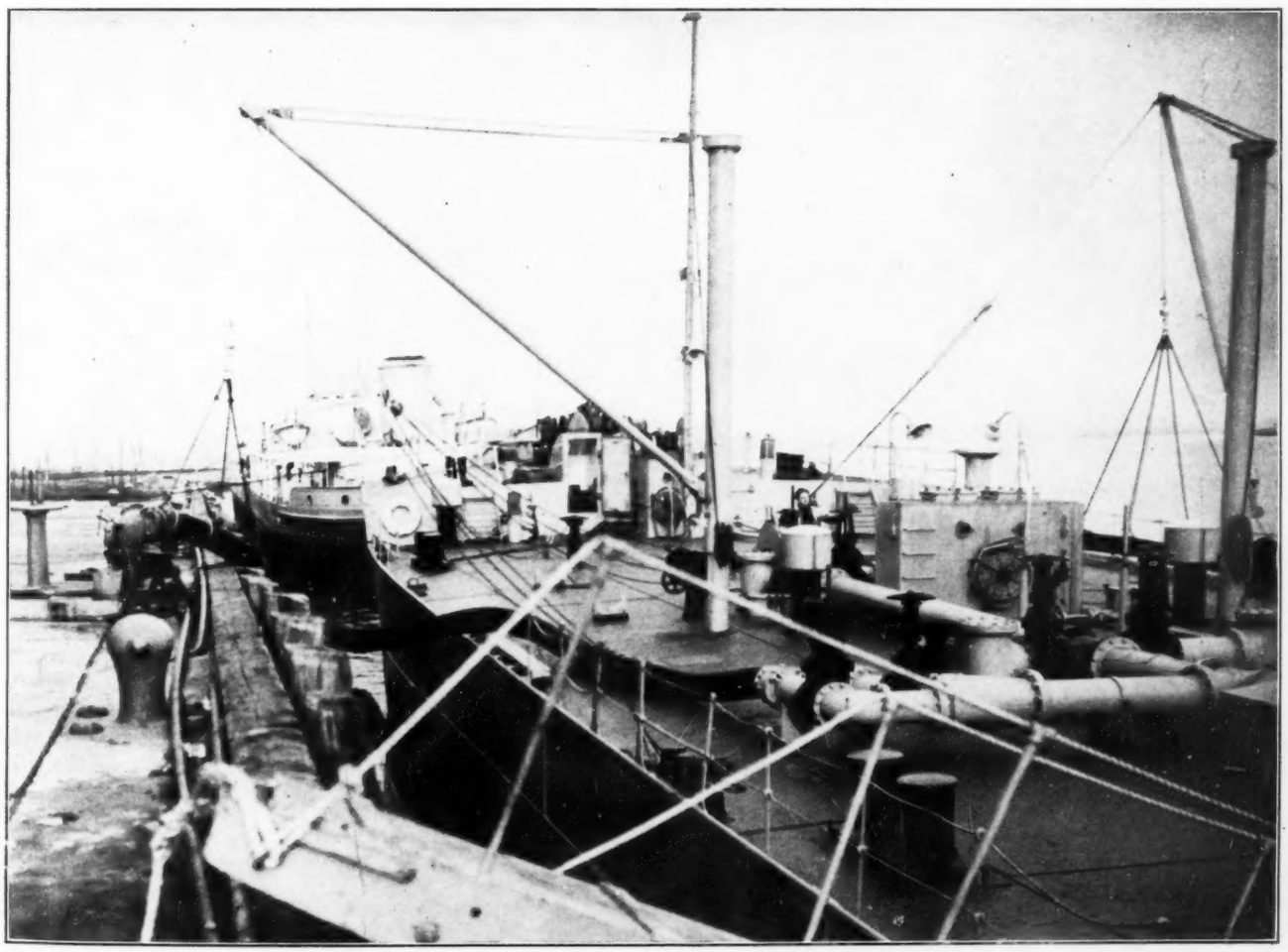
At each of the three plants, namely, Wards Island, Tallmans Island, and Bowery Bay, from which sludge is barged to sea, tanks have been provided for storing the sludge prior to its removal. At Wards Island there are four tanks, two for primary and two for activated sludge, each having a capacity of about 47,500 cubic feet, or a total of 190,000 cubic feet, which is about 3.5 times the 55,000 cubic feet capacity of each sludge vessel. The Tallmans Island Plant has two tanks with a combined capacity of 55,000 cubic feet. In the two Bowery Bay tanks, 60,000 cubic feet of sludge can be stored.

Sludge Loading Practice

Docking facilities are provided at each of the three plants, with sludge discharge lines from the storage tanks to the docks. The boats are loaded in the case of Wards Island and Tallmans Island through a 12-inch cast iron discharge line, and at Bowery Bay the loading line is 18 inches in diameter. The time consumed for loading one boat, which has a capacity of 55,000 cubic feet, is about an hour and a half at Wards Island and approximately two hours at Tallmans Island. At the Bowery Bay Plant, where only primary sludge is produced, the loading time is much greater and varies with the weather conditions and the density of the sludge. At times the sludge removed from this plant has contained about 18% solids and has given difficulties and caused severe strain on pumping facilities.

At the Wards Island Plant the bottom of the sludge storage tanks is about 15 feet above the loading connection on the deck of the boat. Hence, no dewatering or flushing of the discharge line is necessary at this plant.

In the case of Tallmans Island and Bowery Bay, how-



Loading Operations at the Wards Island Dock

Note the distribution piping, dump valve stands and carbon canister loaded odor traps on deck.

ever, the relative position of the storage tanks and the end of the sludge discharge pipes is such as to require dewatering. This is accomplished, after loading, by pumping the contents of the discharge line back into the storage tanks.

Some Cost Records

In the disposal of sewage sludge to sea, like in any other phase of operation, the cost is the essence of the method employed and is of particular interest. Therefore, the cost data of the operation and maintenance of the City's three sludge vessels has been analyzed and studied. These costs are presented herewith in Tables 1 and 2.

In considering these data, it must be borne in mind that the removals in 1938 were from Wards Island only; those for 1939 included also one month's removals from Bowery Bay, and the 1940 quantities represent the total sludge removed from the three plants: Wards Island, Bowery Bay, and Tallmans Island. Attention is also called to the fact that the costs given do not include depreciation or interest on the fixed capital investment of nearly $1,500,000 paid for the vessels. On the basis of a life expectancy of twenty years, with straight line depreciation and 4% interest on the capital outlay, the amortization and interest combined would be equal to about $110,000 per annum or about 80% of the costs presented. The City of New York does not carry accident insurance. Hence this item, too, was not considered in our cost keeping. The exclusion of insurance, however, is probably more than offset by the cost to the City for repairs of damage caused by accidents and which are embodied in our computations. In 1940 alone this expenditure, incurred because of a collision accident to the motor vessel "Coney Island," amounted to nearly $23,000.

Table No. 1

OPERATING AND MAINTENANCE COST OF THE 3 SLUDGE VESSELS

Year	Total Cost	Personal Service Amount	Pct.	Fuel Oil Amount	Pct.	Repairs, Supplies Amount	Pct.
1938	$132,001.73	$ 67,165.67	50.9	$15,722.00	11.9	$ 49,114.06	37.2
1939	137,931.53	97,947.29	71.0	23,763.03	17.2	16,221.21	11.8
1940	165,234.39	89,024.58	53.8	19,326.00	11.7	56,883.81	34.5
Total	$435,167.65	$254,137.54	58.4	$58,811.03	13.5	$122,219.08	28.1

Table No. 2

COST OF SLUDGE DISPOSAL AT SEA FROM NEW YORK SEWAGE TREATMENT PLANTS

(3 Sludge Vessels Used)

ITEM	1938	1939	1940
Sewage flow (M.G.)	61,797	66,662	87,752
Sludge to Sea:			
Number trips	723	1,107	932
Cubic feet	40,082,000	59,012,000	49,723,000
Wet tons	1,262,600	1,859,000	1,567,800
Dry tons	40,202	54,921	68,758
Per cent solids	3.18	2.95	4.38
Operating and Maintenance Cost:			
Total	$132,001.73	$137,931.53	$165,234.39
Per M.G. Sewage	$2.14	$2.07	$1.88
Per Wet Ton	$0.105	$0.075	$0.105
Per Dry Ton	$3.28	$2.51	$2.40

1938—Sludge from Wards Island Plant only.

1939—Sludge from Wards Island and Bowery Bay Plants—
On basis of sewage treated:
W. I. 98.5%; B. B. 1.5%
On basis of cu. ft. and wet tons:
W. I. 99.6%; B. B. 0.4%
On basis of dry tons:
W. I. 98.5%; B. B. 1.5%

1940—Sludge from Wards Island, Bowery Bay and Tallmans Island—
On basis of sewage treated:
W. I. 80.3%; B. B. 13.7%; T. I. 6.0%
On basis of cu. ft. and wet tons:
W. I. 93.7%; B. B. 4.6%; T. I. 1.7%
On basis of dry tons:
W. I. 82.8%; B. B. 13.2%; T. I. 4.0%

Table No. 1 shows the breakdown of the total cost of operation and maintenance of the three vessels into the amounts expended for personnel, fuel, repairs, supplies and materials; the last group includes also food for the men employed on the boats and repairs because of accidents.

In Table No. 2 are given, in addition to sewage treated and number of trips, the quantities of sludge taken to sea and the costs calculated on the basis of various units. The relation of the quantities removed from each location is noted at the bottom of the table.

As previously stated, the cost of sludge disposal decreases with the increase in the solids content of the material removed. The data in Table No. 2 supports this contention. It is to be noted that in spite of the marked increase of sewage treated in 1940, fewer trips were made during that year. The volume of sludge removed was less than in 1939 because of higher concentrations, with the following effect upon the costs: In 1939, with an average per cent solids for the year of 2.95, the cost per dry ton removed was $2.51, while in 1940, when the percentage increased to 4.38, the cost dropped to $2.40. In the aggregate this decrease per ton represents a sizable saving over the years.

In conclusion, it can be stated that the three years' experience in New York City with the disposal of sewage sludge at sea in municipally owned boats proves this flexible method of sludge removal from the system and its positive disposal to be satisfactory, both from the standpoint of operation and of economy.

THE SEA-GOING SLUDGE FLEET OF NEW YORK CITY

By HENRY LIEBMAN, M.E.
Engineer of Design
Dept. of Public Works
NEW YORK CITY

THE problem of sludge disposal has long been conceded one of the most important encountered in the field of sewage treatment. In this phase, as much as in any other, the talents of the mechanical engineer are constantly called into play. Here we are limiting the discussion to the problem of sludge disposal at sea, and this particular paper will describe the main features of the sludge vessels built for and operated by New York City.

Preliminary plans for the 180 M.G.D. Wards Island Treatment Plant called for disposal at sea for two-thirds of the sludge produced and fertilizer recovery for one-third. However, the fertilizer plant was not built and, today, sea disposal of the entire sludge load is being employed. For the purpose, three sludge vessels were contracted for and built by the United Shipyards, Inc., of Staten Island from plans prepared by the naval architect firm of Cox & Stevens under the supervision of the Bureau of Sewage Disposal. The boats cost about $500,000 each, part of which was defrayed by a 45% P.W.A. grant.

The Three Vessel Fleet

The boats are trim, sturdy, seagoing craft, twin screw, Diesel propelled, of rather unique design. They differ in construction from ordinary tankers because of the manner in which they carry their cargo. Painted and decorated in good taste, the accompanying pictures will reveal that they present the pleasing appearance of smart yachts and the general public little suspects the utilitarian service performed by these ships. Although each has a cruising radius of 2,500 miles, Government permission has been obtained to travel only up to 300 miles to sea.

The principal dimensions and specifications of the boats are: Length overall, 257 feet 3 inches; beam molded, 43 feet 6 inches; depth molded amidships, 16 feet; mean load draft molded, 11 feet; draft light, 5 feet; cargo, 1,584 tons; sludge capacity, 55,400 cubic feet; horsepower specified, 1,300; actual, 1,430; specified speed loaded, 10¼ knots, speed light, 10¾ knots (although on test this was bettered by one knot): fuel oils, 826 tons; water, 10 tons.

The Author

The hull and superstructure are built of steel throughout, excepting the house tops, which are made of wood. The hull has two decks, a straight stem and round overhanging stern. Six main transverse bulkheads extending from the keel to the underside of the main deck form seven watertight compartments. The six sludge compartments, located amidship, are formed by a continu-

Motor Vessel "Wards Island"

Riding light and coming up to the Wards Island plant, dock through swirling Hell's Gate—two of the reasons for stressing design for good maneuverability involving twin rudders and propellers. These ships can all but turn about on a dime.

ous centerline watertight bulkhead and four transverse watertight bulkheads. In addition, there are transverse swash bulkheads in the sludge compartments which act to prevent surging of the sludge when the boat is pitching. The compartments are coated with bituminous primer and hot applied enamel. They are arranged three on each side, extending from the main deck to a point 6 feet below the main deck (see sketch).

All-Gravity Loading And Unloading

The novel feature of these vessels is that when loaded, the surface of the sludge load is 5 feet above the waterline, and when unloaded the bottom of the sludge compartments are about 9 inches above the waterline. The space below the sludge compartment floor and the hull acts as a buoyancy chamber. Because of this construction, unloading at sea becomes a quickly completed gravity discharge operation. When the sludge valves are opened, the five-foot head forces the sludge to run out rapidly, and the boat rises until the bottom of the compartments are above the waterline, making it possible to completely empty the tanks.

Since the sludge, as collected, is stored at each plant in elevated steel tanks located in the Sludge Storage Building, it also flows into the boat by gravity. The loading and unloading are thereby carried out without pumping, which results in efficient and economical operation. The boats can be loaded at the Wards Island Plant in about 90 minutes and unloaded in as little as 5 minutes. There are 12 unloading devices, two to each chamber. They consist of sections of 18-inch wrought iron watertight pipes extending from the bottom of the sludge compartment down through the buoyancy chamber to the bottom of the ship. At the top of these pipes, in the compartment, are fitted plug valves with steel extended rising stems operated by means of handwheels on valve stands located on the main deck (see cut).

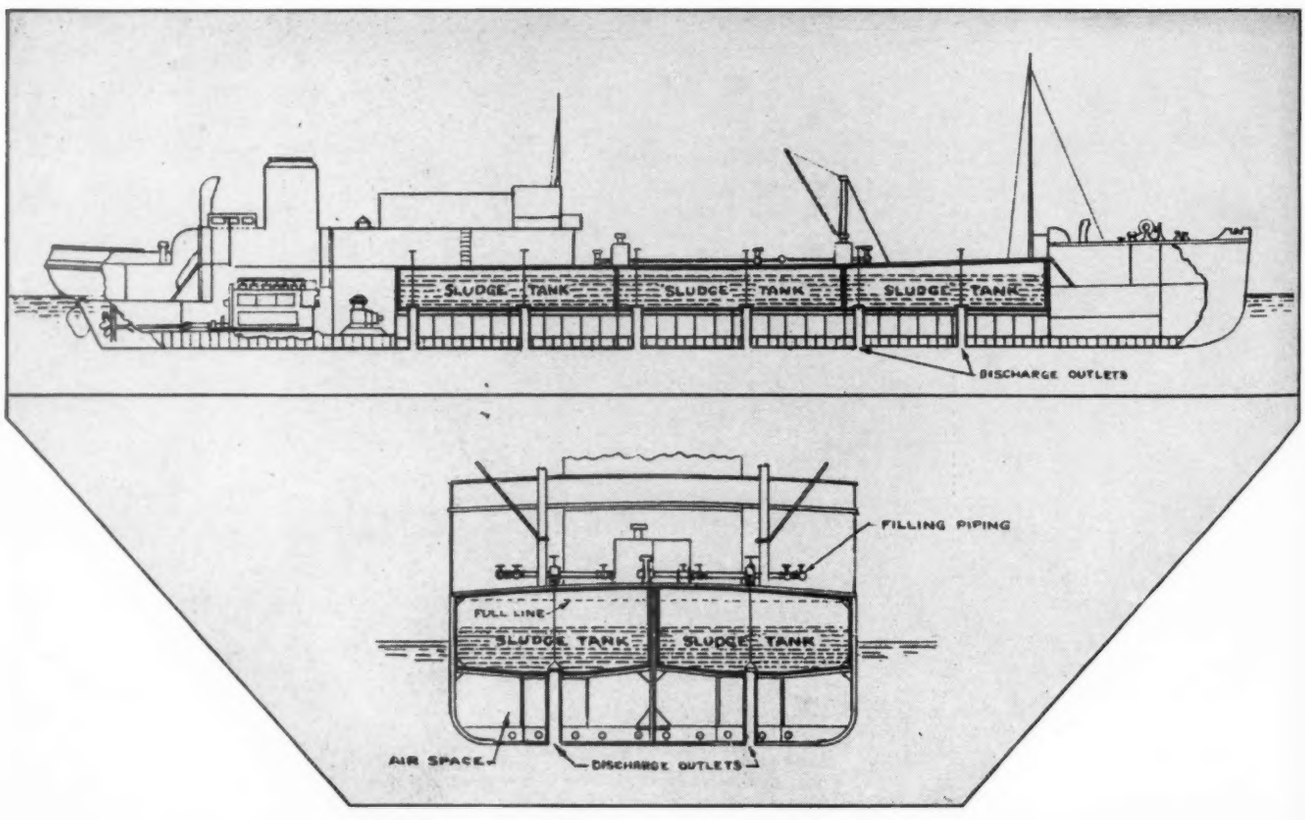
Along the centerline on the main deck is the sludge filling line 14 inches in diameter, with separate valved connections to each of the six tanks, and filling connections located both port and starboard to permit loading from either side. At each of the outer ends of the filling connections is a Y ending in two 10-inch pipes. When loading, two flexible hoses 10 inches in diameter connect these points to the shore connections which lead from the dock to the sludge tanks in the Sludge Storage Building. Each compartment is equipped with a vertical float gauge, overflow connections, and vents with odor traps mentioned in Mr. Kass' paper.

The underdeck forward of the sludge tanks is utilized for the fore peak tanks, workshop, storerooms and ballast rooms. The portion aft is occupied by the engine room, aft peak tanks, fuel and water tanks, steering compartment and oilers' quarters.

Mounted on the forecastle deck is an electrically-driven windlass for raising the 3,500-pound anchors. It is capable of raising each of them from a depth of 30 fathoms of water at a chain speed of 24 feet per minute. Near the stern is an electrically-driven vertical capstan, capable of developing a pull of 6,000 pounds at a rope speed of 35 feet per minute. This unit is used in handling ropes or cables and docking and shifting a vessel.

Maneuverability Stressed

In order to provide greater maneuverability (especially since the boats only draw 5 feet when light) it was decided to install twin propellers and twin rudders. The propellers are made of manganese bronze, three blade solid type, 7 feet 3 inches in diameter, turning at about 270 r.p.m. The rudders of the double spade type are controlled by a steering engine



Longitudinal and Cross Sections of New York's Sludge Vessels

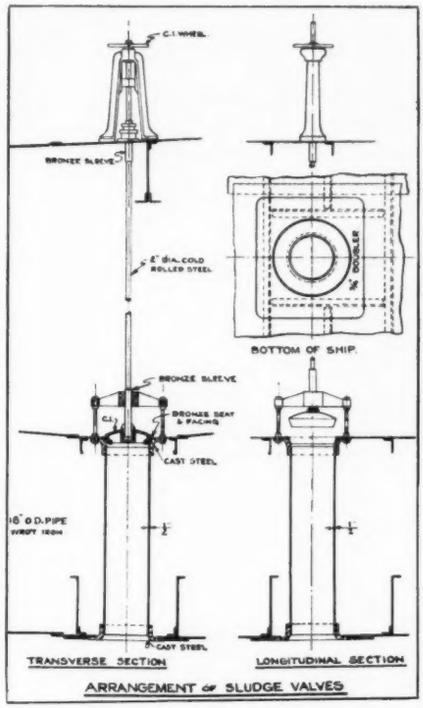
Note elevation of sludge compartments in respect to water line. As the tanks empty the ships ride up until the dump valves are 9 inches above water line. Details of dump valves and tanks are shown in other cuts.

built by the American Engineering Company of the electro-hydraulic opposed ram, tiller type gear, actuated by variable stroke reversible motor-driven pumps; control is located at the pilot house and transmitted by means of a hydraulic telemotor. In addition, local control was provided for emergency use. This duplicate installation has proved very successful in controlling the movements of these vessels which have to travel continually through the busy port of New York and the difficult East River "Hell-Gate," on which the Wards Island Plant is situated.

The crew quarters are located in the deckhouse, the officers in the upper deckhouse, the balance of the crew in the main deckhouse, and the oilers abaft the engine room on the lower deck. All quarters are comfortably furnished with simple, modern, metal furniture. The galley and mess rooms are located in the main deck house. The pilot house contains the compass, steering telemotor, telegraph, radio, chart, lockers and other navigation instruments.

Engine Room Particularly Interesting

The engine room is probably of greater interest to this group than the preceding matters touched upon. The boats are driven by means of two Diesel engines, such being chosen because of their greater economy of operation, smaller space requirements, instant readiness for service, ease of operation and repair. Two Ingersoll-Rand direct reversible 6 cylinder, 16x20, 4 cycle, solid injection heavy oil marine units (required by specifications to develop 650 HP. at 260 r.p.m.) were installed in each vessel. The specifications also called for the engines to deliver a continuous 10% overload at 270 r.p.m. The engines were completely shop tested in the presence of representatives of the Naval Architect, the American Bureau of Shipping, and the city. Each engine was run for 12 hours at 715 BHP. at 270 r.p.m. and actually were loaded up to about 900 HP., which happened to be the upper limit of the hydraulic testing device. Readings were taken of pressure, temperatures, and fuel consumption. The engines developed a BHP. hour on .39 of a pound of oil. After load tests, the engines were put through reversing tests. The latter important test was repeated after installation with all shafting and propellers in place when the engines were reversed four times a minute from full speed in one direction to full speed in the other. The engines are directly connected to the

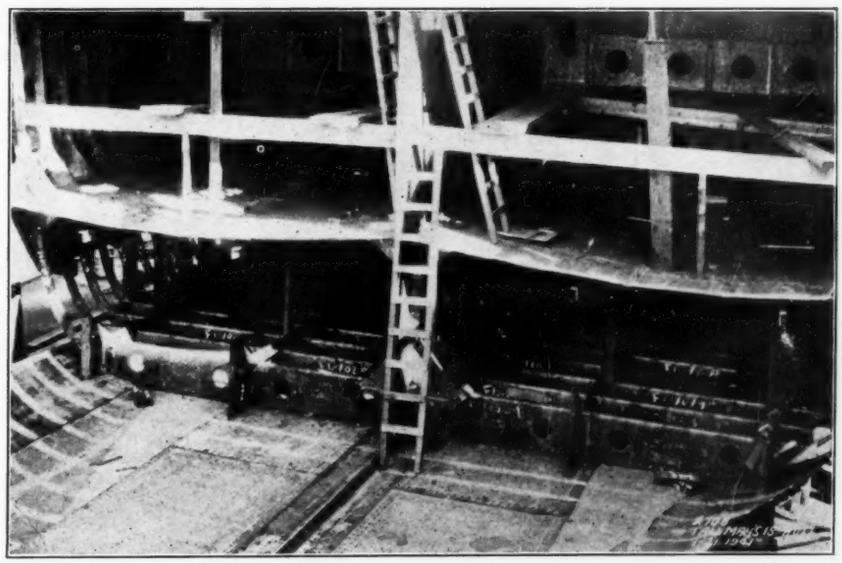


Details of Unloading Valves

Note 18" drop tube through buoyancy chamber to ship's bottom. Quick opening valves operated from wheel stands on deck. Two to each of the six tanks permit full load dumping of 55,000 cu. ft. of sludge in 5 minutes.

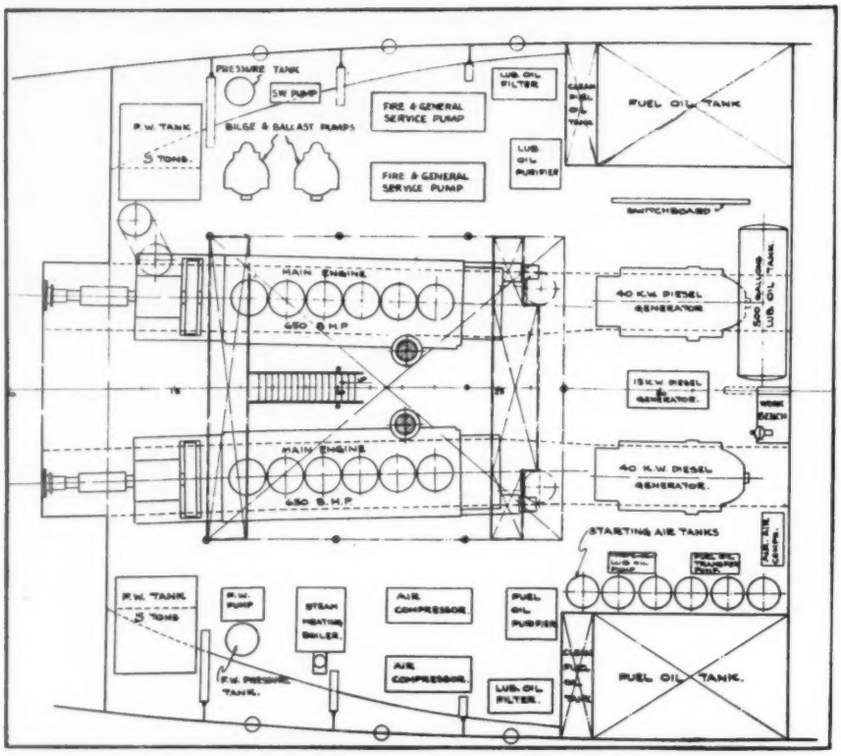
driving shafts by Kingsbury thrust bearings secured to the extended engine bedplate. One engine is left hand and the other right hand, so placed that the propellers are outboard turning when driving ahead to assure prompt rudder response. A unique feature of this type is the interchange of manifolds. When reversing, the intake manifold becomes the exhaust manifold and the exhaust manifold becomes the intake. For this reason, mufflers are mounted on both lines. The construction of the engines include box type housing, wet liners, chain driven overhead ram shaft, force feed lubrication, and the Price system of fuel injection. The engines were designed for salt water cooling of cylinder liners, heads, and valve cages. After being placed in operation, it was necessary to change the cooling system from an open to a closed system using fresh water in the engine jackets. This was necessary since a lot of foreign material was being brought into the engines and at times the sea water was not cold enough to keep the jacket temperatures below the possible salt caking point.

The engines are started by means of compressed air. All working cylinders of the main engines are fitted with necessary valves for admission of starting air. Starting air is furnished by two electrically-driven Ingersoll-Rand compressors, duplex, two-stage, with water-cooled intercooler, operating at 875 r.p.m., having a capacity of 40 cubic feet of free air per minute of a discharge pressure of 500 pounds. Each compressor is fitted with pressure gauges, relief valve, blow-down and stop valves and equipped for automatic pressure control. There is also an auxiliary compressor, one stage, air cooled, with a capacity of 8 cubic feet per minute against a pressure of 500 pounds per square inch. The starting air is stored in six air tanks of welded construction, having a capacity of 24 cubic feet each, designed for a working pressure of 500 pounds per square inch and fitted with all the necessary valves, drains, relief valves and gauges.



Construction Photograph

Transverse section—sludge compartments above and buoyancy chambers beneath.



Engine Room Plan and Location of Various Units
(For details concerning this compact and unique arrangement, see text.)

All auxiliary power required on the boat is generated by three Diesel direct current generators, all operating in parallel. There are two 40 kw. Hill marine Diesels, four cycle, solid injection, direct connected units. They have six cylinders and operate at 400 r.p.m. In addition, one 15 kw. Hill Diesel was installed for standby service. The main switchboard is mounted in the engine room. All electrical work meets with the requirements of the Marine Rules of the A. I. E. E.

Pumps

Two vertically-driven Aldrich 5x6 inch Drysdale type vertical pumps having a capacity of 600 gallons per minute against a head of 40 feet are used for bilge and ballast service. They are centrifugal pumps, motor-driven, with a built-in plunger pump for self priming purposes.

Two fire and general service pumps having a capacity of 200 gallons per minute against 100 pounds per square inch to 440 gallons per minute against 50 pounds, with a shut-off head of 120 pounds per square inch are installed. They are Warren pumps, direct connected, motor-driven, centrifugal.

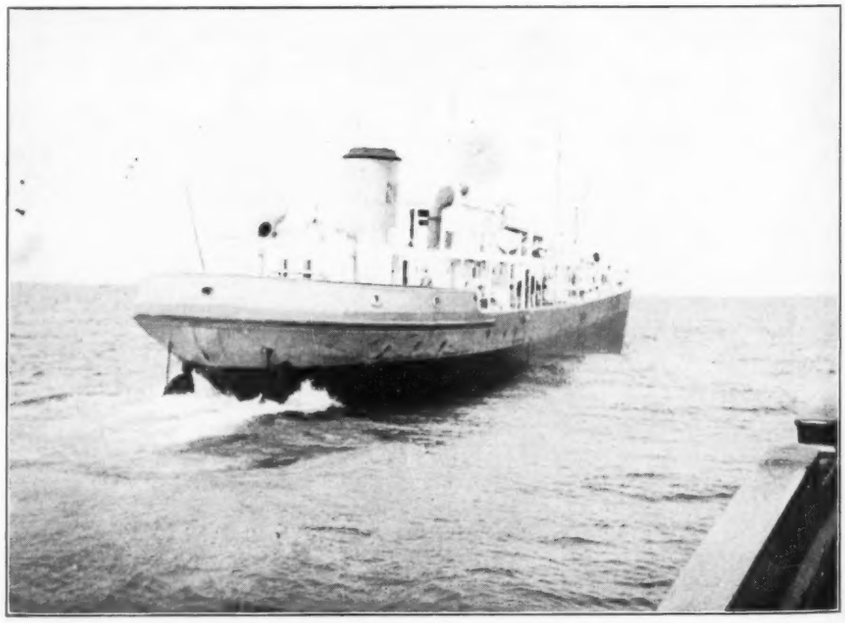
In addition to the pumps mentioned above, there are fuel oil transfer pumps, Lube oil pumps and cooling water pumps. The cooling water pumps are capable of delivering 140 gallons per minute against a discharge head of 70 feet. They are motor-driven Cameron centrifugals. These pumps originally used for pumping sea water, are now used for circulating fresh water through the engine jackets and the shell of the heat exchanger. A vertically-driven positive type Aldrich pump is now used for pumping sea water through the tubes of the heat exchanger. With this arrangement, any foreign material contained in the sea water is kept out of the engines and can easily be removed by cleaning the exchanger tubes.

The engine exhausts are all fitted with Maxim silencers. All exhaust piping is made of standard weight, wrought steel pipe, with screwed steel flanges. A section of seamless, flexible tubing connects each exhaust line with the engine to take care of expansion and eliminate vibration. All exhaust lines are well insulated.

Lubricating and Fuel Oil Systems

Lubricating oil is stored in a 500 gallon steel tank, suspended from the underside of the main deck in the engine room, so that there is gravity flow to all filter tanks and the purifier. The Lube oil pumps of the main engine and generators draw fuel oil from the filter tanks and discharge through oil coolers to the pressure lubricating systems of the engines and back to the filter tanks. Strainers, gauges and thermometers are installed to properly regulate the systems. Nugent filters, which are bag-type filters, were also inserted in the lines. A Gould Hydroil motor-driven centrifugal purifier draws the dirty oil from the dirty oil lube tank, cleans it and returns it to the filter tank.

The fuel oil tanks are located underneath the engine room and store about 82½ tons of oil. Small gravity supply tanks of about 200 gallons capacity each are located in the engine room above the engine fuel pumps. Another Gould Hydroil motor-driven centrifugal oil purifier



"Going Home"—Leaving the Dumping Grounds
A good picture of quarter view of ship running light, with twin rudders exposed and twin propellers making white water.

has been installed to filter the fuel oil and discharge to the gravity tanks and also to the clean oil fuel tanks. The gravity tanks are fitted with gauge glasses, with calibrated scales, filling vent overflow and drain connections, also handholds for cleaning.

All living quarters in the boat, main deck houses and the engine room are heated by steam. A York oil burning steam boiler was supplied for this purpose and is located in the engine room.

Ventilation in the main is provided by Cowls' gooseneck vents and ports. In addition to this natural ventilation, the engine room is provided with a ventilating fan with a capacity of 5,000 cfm.

For fire protection of the engine room, galley, lamp and paint rooms, a Smith-Meeker CO_2 fire extinguishing system was installed. The carbon dioxide filled cylinders are connected to the manifold with devices which are automatically controlled. In case of fire, the area affected is instantly flooded with the smothering CO_2 gas. In addition, the usual extinguishers, hose, hydrants and other fire-fighting equipment were installed.

These boats were built to meet the requirements of the American Bureau of Shipping, which is the American equivalent of the Lloyds of London, and also the rules and regulations of the U. S. Steamboat Construction Service. They are giving efficient and reliable service and, aside from slight mishaps which are bound to occur to vessels plying continually in New York harbor, no fault has been found with their performance.

SLUDGE DISPOSAL AT SEA

Experiences of the Elizabeth Valley Joint Meeting

By LESLIE E. WEST
Chief Engineer
ELIZABETH VALLEY JOINT MEETING
ELIZABETH, N. J.

THE second largest cooperative sewerage enterprise in New Jersey is known as the "Joint Meeting of Municipalities in Essex and Union Counties." At this writing twelve separate communities, with an estimated aggregate contributing population of some 300,000 persons, are served by this Commission managed authority.

The "Joint Meeting" treatment plant, situated in the southeastern section of Elizabeth, N. J., near Arthur Kill (Staten Island Sound), has a capacity of 100 M.G.D. if rated on two hours of detention in the sedimentation tanks. However, during 1940 the average daily flow handled amounted to 28.04 m.g.d. only.

With due consideration given to the volume and type of the sewage and to the receiving waters, as classified by the Interstate Sanitation Commission, the following degree of treatment has been deemed sufficient

1. Removal of screenings and grit.
2. Primary sedimentation.
3. Chlorination.
4. Removal of raw sludge to storage.
5. Concentration and disposal at sea.

At this plant the disposal of sludge is perhaps the most important single function of the treatment process, as well as the most troublesome and costly. The cost of operation is in a great measure directly related to the volume of sludge produced and barged to sea. In the operation of the plant it has been readily possible to collect fresh sludge containing

The Author

from 5 to 6 per cent solids, and to concentrate it thereafter to from 7 to 10 per cent solids as delivered to the barge. The reduction of sludge volume and the control of production has thus afforded an important source of economy in operation by reason of the fact that the cost of disposal of sludge at sea is based on volume or weight alone, regardless of the percentage of dry solids present within reasonable limits.

At the present time the plan of plant operation provides for the continuous removal of screenings and grit 24 hours daily, and of all other operations as far as possible during the day shifts. The delivery of sludge into the barge for sea disposal is dependent upon a number of variable factors. The principal factors, however, are weather and tides, and the loading may be either a day or night operation.

For a better understanding of the entire subject of the disposal of sewage sludge at sea, as practiced by the Joint Meeting, the story should properly start from the beginning—namely, the collection of the sludge, and continue through to the final operations at sea.

Sedimentation Tank Operation

The crude sewage is, as a rule, delivered into two of the four available settling tanks. Under average flow conditions, the resultant detention period is about 3¼ hours, with one-half of the sedimentation in capacity in use. Each of the four rectangular concrete tanks is 280 feet long and 75 feet wide, with an average flow depth of 13 feet. Adjustable effluent weirs (elevations 3.0 to 6.4 feet) provide additional tank capacity for increasing the calculated detention periods. The present selected setting of these weirs, at the intermediate elevation 4.0, eliminates slow velocities and also prevents sedimentation in the influent flumes under the present-day low flow conditions. Appurtenances of each tank include perforated inlet baffles for distribution of flow, scum baffles in front of the effluent weirs, and a scum sump from which the removal of scum is effected by pneumatic ejectors.

For the collection of sludge and scum there are provided two Link-Belt Traveling Bridge Collectors of the Mieder type. Each is adaptable for use in any tank for scraping the bottom or skimming the top, as desired. At the influent end of each tank a lateral trough, equipped with a Link-Belt "Straightline" cross collector, provides means for the concentration of the crude sludge in a deep sump, from which it is pumped to storage for additional concentra-

tion. The concentrated sludge is then delivered to the removal contractor's sea-going barge through a sludge pumping main.

The Sludge and Scum Collectors

The flexible traveling bridge sludge collectors are self-propelled machines of the tractor crane type, with a clear span of 75 feet. While traveling from the outlet end of the tank toward the inlet end, the scraper blade is lowered to the bottom of the tank, and the settled sludge is pushed, after the manner of a "bull-dozer," toward the cross-collector and sludge sump at the inlet end. Thereafter the blade is raised to the surface of the sewage and during the back-tracking accumulating scum is swept from the surface and concentrated in the narrow space between the scum baffle at the outlet end of the tanks and the blade. The flotables then transferred to a scum sump by hand are removed therefrom by a compressed air ejector and delivered to the sludge and scum concentration and storage tanks.

While skimming, the velocity of travel of the collector unit is from 5 to 10 feet a minute; while collecting sludge, 2 to 3 ft./min., and while cruising (when skimming is not required), as high as 75 feet a minute.

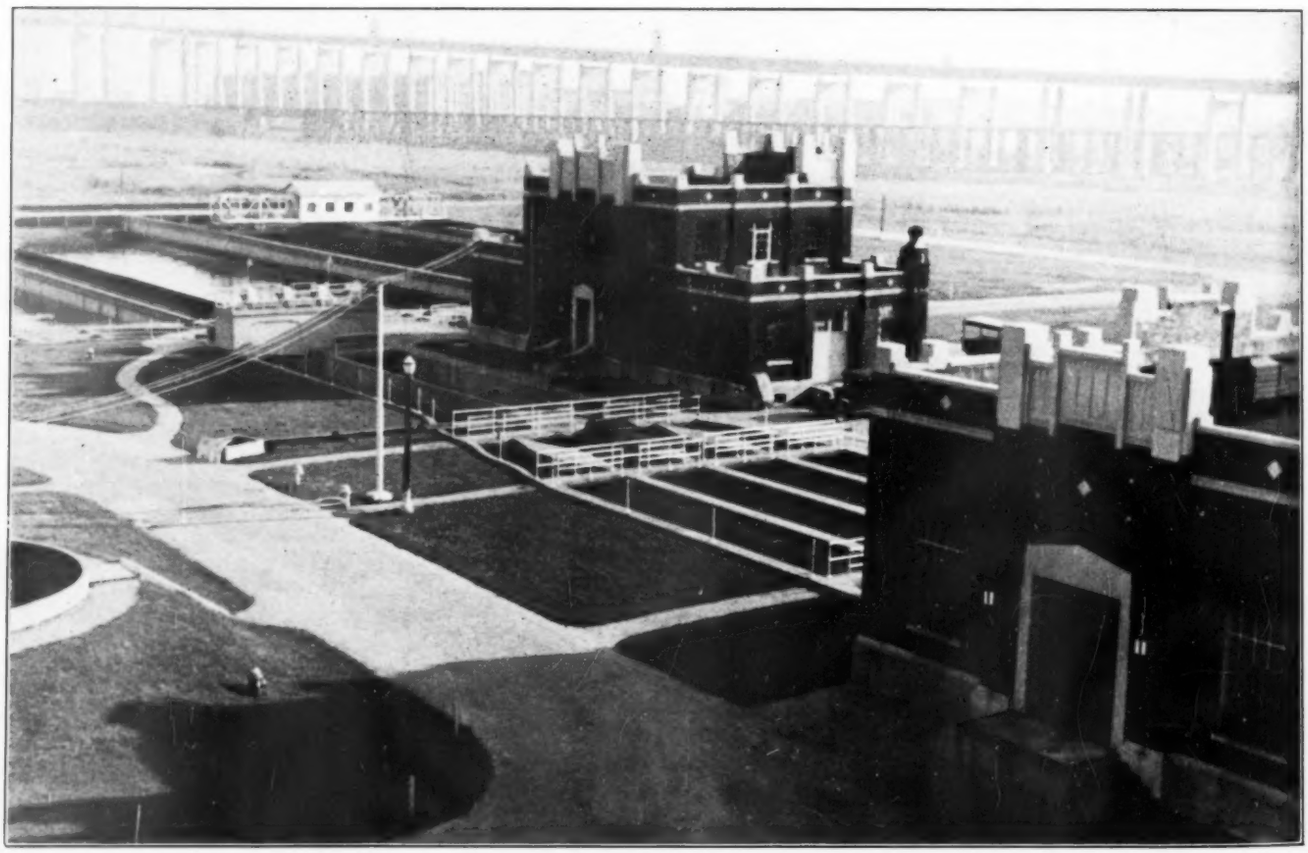
The scraping blade, approximately 3 feet high by 75 feet wide, is equipped on its lower side with a strip of ½ by 6 inch gum rubber. In use this strip is slightly compressed against the tank floor, the weight of the blade proper being carried by steel wearing shoes which ride on the top of heavy steel rails imbedded in the concrete tank floor and flush with it. In addition to providing a replaceable wearing surface, this arrangement permits exceptionally smooth action of the scraper blade, with no noticeable agitation or disturbance of the sludge blanket during collection.

In operation it has been found practicable to remove the accumulation of sludge during the day shift only. About five complete trips of the collector daily serve to collect all of the sludge which settles. Average removal of suspended solids during 1940 was 69.7 per cent, and of settleable solids 95.6 per cent.

The clarified sewage, after passing over the effluent weirs, is conducted through an effluent channel, through twin 84x42 inch Venturi meters and a twin rectangular outfall sewer, about a quarter of a mile long, to the Outfall Diffusion Chamber, at which point it is discharged into the tidal current of Arthur-Kill, some 20 feet below the surface.

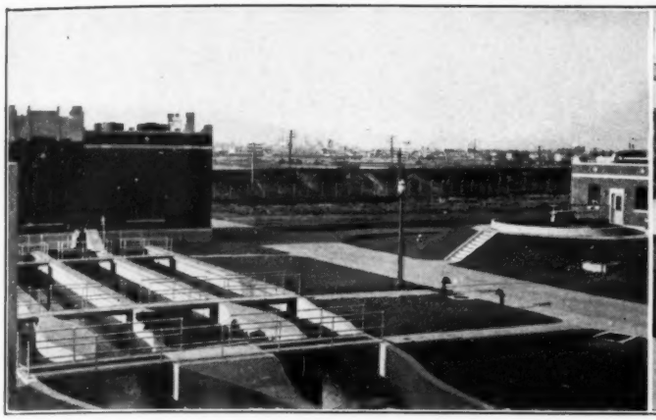
Practices in Sludge Collection

The fresh sludge, which is concentrated in the sludge sumps of the sedimentation tanks, is withdrawn daily. For this purpose Barnes-Dorrco Duplex plunger type sludge pumps are used. Arrangements have been provided whereby sludge can be withdrawn simultaneously from two tanks through separate sludge suction lines, and in that way two or three sludge pumps can be operated at a given time, in series or in parallel. Usually two costant speed pumps work together on separate suction lines delivering sludge to storage at a rate of between 225 to 250 gallons per minute from the two sedimentation tanks in use. Samples are run out at the pumps from time to time to observe sludge quality, and composites are taken every 15 minutes from the common discharge line for subsequent laboratory analysis. As a point of interest it may be mentioned that average solids content varies from 5 per cent during cold weather to 6 per cent during warm

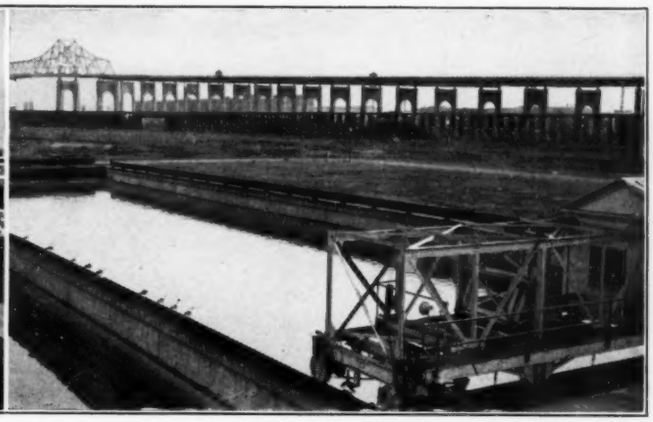


Sewage Treatment Works of the Elizabeth Valley Joint Meeting.—Elizabeth, N. J.

This partial view of the plant shows Screening Building (right foreground); Grit Chambers (center) and Administration Building beyond. In far left, two of four Settling Tanks showing one of the two sludge and scum collectors of the traveling-bridge type.



Grit Chambers and Portion of Sludge Handling Station on Right



Settling Tanks, and Portion of Travelling Bridge Collector.

weather, averaging over the entire year about 5.5 per cent.

Some Observations in Sludge Concentration

It was contemplated in the design of the Elizabeth Valley plant to secure a thickened sludge by chemical means if necessary. As operations were begun, however, such effective thickening became possible by methods of flotation and by decantation of the relatively clear liquor beneath that the chemical method has never proved necessary.

In regular practice the fresh sludge is pumped daily into storage until about 5,000 tons has been accumulated. This figure has been arrived at as the result of experience in loading the 3,500 ton capacity sludge barge. There are two reinforced concrete sludge storage tanks at the plant, each 70 feet in diameter and having 23.8 feet of effective side depth, and each with a capacity of 626,000 gallons or 2,730 tons. For odor control each tank is equipped with a floating cover. The tanks are unheated, and efforts are made to keep the sludge as fresh as possible. Nevertheless partial digestion occurs during a good part of the year, and the gases evolved during such stages are vented to the atmosphere at an elevation of 30 feet above ground level. During the cold season, when 50 degree sludge temperatures prevail, practically no digestion occurs and little if any gas is evolved. The evolution of gas from these early stages of digestion appears to be of benefit to the process of concentration by flotation.

At Elizabeth we have been conducting experiments with composited fresh sludge to determine just how much separated water becomes available during storage; how long a storage period is necessary for various degrees of concentration; how the seasonal effects of temperature on the rate of digestion affect the process. At the same time we continue to make comparisons with full plant scale operation to check on what our experimental observations predict will occur.

While we are not ready to report on our findings at this time, some few sludge characteristics we have found may prove to be of interest. For example, the following notes were made concerning a composite sample of crude sludge removed from the sedimentation tanks and stored for concentration in June, 1940. Having an original solids content of 6.12 per cent and ash content of 23.1 per cent, it was stored at an average temperature of 70 degrees F. At intervals listed below, certain measurements were taken.

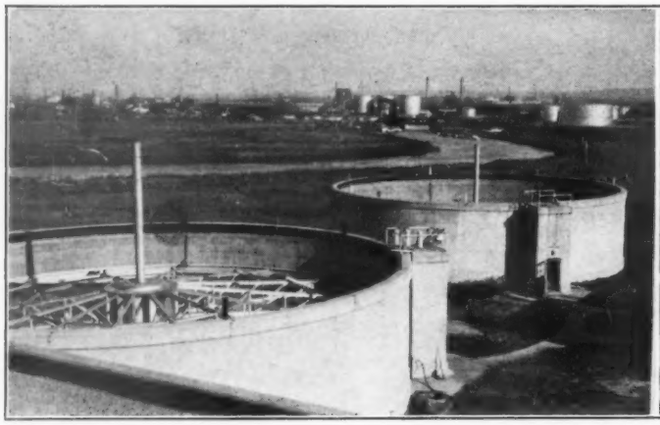
Length of Storage Period	Observed Volume in Storage	Liquor Available for Decantation	Liquor Position in Storage Tank	Net Expanded Volume Minus Decantation	Per Cent Reduction of Original Volume
0 hrs.....	8200 c.c.	None	.....	8200 c.c.	None
24 hrs.....	8400 c.c.	1500 c.c.	Bottom	6900 c.c.	18.3
48 hrs.....	8800 c.c.	2500 c.c.	Bottom	6300 c.c.	30.5
72 hrs.....	9300 c.c.	3300 c.c.	Bottom	6000 c.c.	40.2
96 hrs.....	9800 c.c.	3800 c.c.	Bottom	6000 c.c.	46.4

You will note from above that during our experiments the liquor was not decanted as it became available, as is our practice in regular operation, but was left to accumulate without disturbance. As digestion set in, gasification caused an expansion in volume over the original, progressively increasing until the original volume had been increased by almost 20 per cent. Although the withdrawal of 3800 cc. of separated liquor from the initial volume of 8200 cc. of 6.12 per cent sludge would have resulted in the theoretical concentration of the sludge to 11.42 per cent solids overall, actually a sample of the topmost sludge analyzed 12.40 per cent solids, with ash content of 24.40 per cent. A sludge of this consistency is no longer liquid but rather a plastic of the nature of putty or cheese.

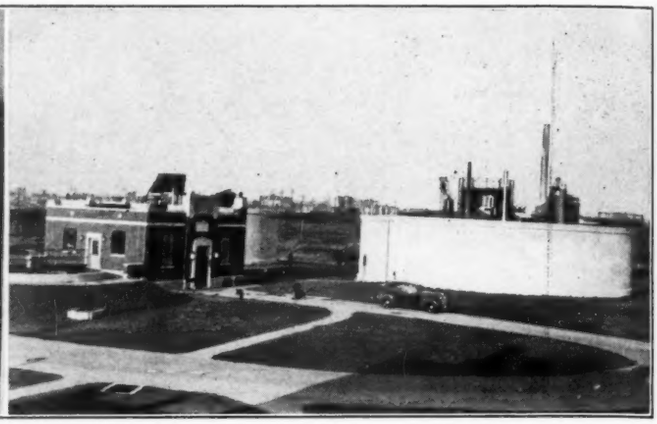
In contrast, a 6 per cent sludge with 20 per cent ash stored in December, at say 60 degrees F., shows markedly different characteristics. First, there is no appreciable change in volume in 96 hours. Second, the stratification, whereby decantable liquor becomes available, is not so readily apparent to the eye. In fact, it almost appears as if none is there. On plant scale it is found, however, that somewhat erratic decantation to the extent of about 25 to 30 per cent of the initial stored volume is possible. The hydrogen ion concentration of sludge in both winter and summer remains fairly constant at about pH 5.3.

In practical operation, liquor from the two storage tanks is withdrawn most of the time from the *lowest* of the valves provided on the sides of the storage tanks for the purpose. This particular valve is 5 feet above the floor level of the tank. Other valves are placed at approximately 3 foot intervals above it to a point 3 feet below the surface of the contents at capacity.

Primarily because of the offensive odor of the liquor, discharge from these valves occurs in an isolated decantation chamber, provided with alarms to protect against overflow in the event of stoppage. The decanted liquor is conducted by gravity through a 6 inch diameter cast iron



Sludge Storage and Decanting Tanks of Floating Cover.



Sludge Thickening Tank, Pump House and Twin Storage Tanks.

Consistency regulated undigested sludge, of 5 per cent to 6 per cent solids, is centrifugally pumped through 4,400 ft. of 24-in. C.I. force main to the barge dock.

pipe line to the influent channel, where it is mixed with incoming sewage. The return of this liquid to the sewage has had no ill effects upon plant operation, as evidenced by the results of treatment obtained.

Sludge Pumping and Barge Loading

Loadings of sludge into the barge, for disposal at sea, are made about twice a month. For this purpose the Joint Meeting leases a dock at the waterfront under agreement to load 3500 tons within 5 hours. This length of time we have found to be too short in terms of the average. It should have been 7 hours.

For moving the sludge through the 4400-foot 24-inch force main to the waterfront two centrifugal pumps are employed. One unit is an American Well Works 8-inch pump with 30 HP. motor, which at 860 R.P.M. is rated at 2000 g.p.m. against 40-foot head. The other is a 10x8-inch De Laval Clogless type pump with 40 HP. motor. At 590 R.P.M. it is rated at 3000 g.p.m. against 37-foot head.

If the sludge as loaded had characteristics of water, or even of freshly collected raw sludge, these pumps could load the barge within 2 hours. Unfortunately this is not the case. Experience has shown that *temperature, solids content* and *uniformity* in sludge are of utmost importance for higher pumping rates. When, during a loading, the sludge falls to below 92 per cent water, cavitation occurs. It simply refuses to flow by gravity to the suction ends of the pumps fast enough to satisfy the demand called for by the impeller speeds. Then, too, heads due to friction in the force main are noticed to increase as the solids content increases and the temperature decreases. Total heads of more than 50 feet have frequently been encountered during cold weather, as compared to 15 feet under optimum conditions. Means provided for the use of compressed air to clear out the main, when pumping stalls or slows down greatly, have proven eminently satisfactory. "Conditioning" the tanks before pumping, in an effort to improve the consistency of the material, was an early recognized necessity. In the early years of operation this was accomplished by the use of water added through fire hoses under 60 lbs. pressure. This jetting was employed from time to time as required, and although satisfactory as far as it went, was disadvantageous because of the limited volume available, related to the rate of discharge required, and the expense involved in purchase of the water and added barging costs. In other words, we paid for the water and paid again for its barging to sea at sludge barging rates.

During May, 1940, after considerable study, means for conditioning stored sludge by pumped recirculation of tank contents were provided. The arrangements include the use of the 3000 g.p.m. De Laval pump to pump fresh sludge or liquor present in the bottom of either storage tank into the top of the same tank or the other. When neither liquor nor fresh sludge is available, raw sewage from the influent channel can be utilized, this at the rate of about 2500 g.p.m. Usually 2½ hours of recirculation per tank are given before loading operations are scheduled to begin.

When, during the loading, rates of pumping drop excessively, compressed air is brought into play to empty the force main, and the pumps are examined for stoppages and cleaned if necessary. After cleaning and still while the air is being used, sewage may again be added to the tops of either or both storage tanks as desired. Following such steps, the resumption of pumping is at once marked with a much higher rate of discharged than formerly observed. This recovered rate then gradually drops until the resulting state of affairs necessitates a repetition of the procedure. Temperature of the sludge to be pumped has considerable effect upon the rates possible. Other things being equal, at 50 degrees F. the observed rates are much *lower* than at 70 degrees F., accountable only as from increased friction. Winter loadings have required as much as 10 hours for 3500 tons (1350 gals. per minute average). The record loading which occurred August 3, 1940, saw 3475 tons of 7.86 per cent solids sludge pumped through the 4400-foot 24-inch force main in 2 hours and 23 minutes, an average rate of 5595 gals. per minute or approximately 800 pounds per second.

For improvement from the standpoint of time possible to be saved in the loading, we are hoping shortly to install still another 2000 g.p.m. pump for the exclusive purpose of adding sewage at various rates to the recirculating lines, for sluicing the heavy material while the present two sludge pumps are actually loading the mixture of sewage and sludge into the barge.

Such a practice as this becomes truly a necessity when, for example, a layer of 10 per cent solids sludge is encountered and the time available for loading is limited. Such material actually will not flow from the storage tanks to the pumps unless broken up by mechanical means, or sluiced by the addition of sewage or pushed by compressed air. Indica-

tions are that sluicing will be the most economical and satisfactory aid under our conditions.

In our use of this imperfect and makeshift recirculation system, installed by us as an afterthought, we realize that positive "conditioning" of all of the sludge in storage is not possible before pumping. The suggested provision of an adequate source of sluicing water seems to have definite promise of improving withdrawal rates, as repeatedly observed by the beneficial effects of a single fire hose, with only one-tenth the volume which we hope will become available with the new pump.

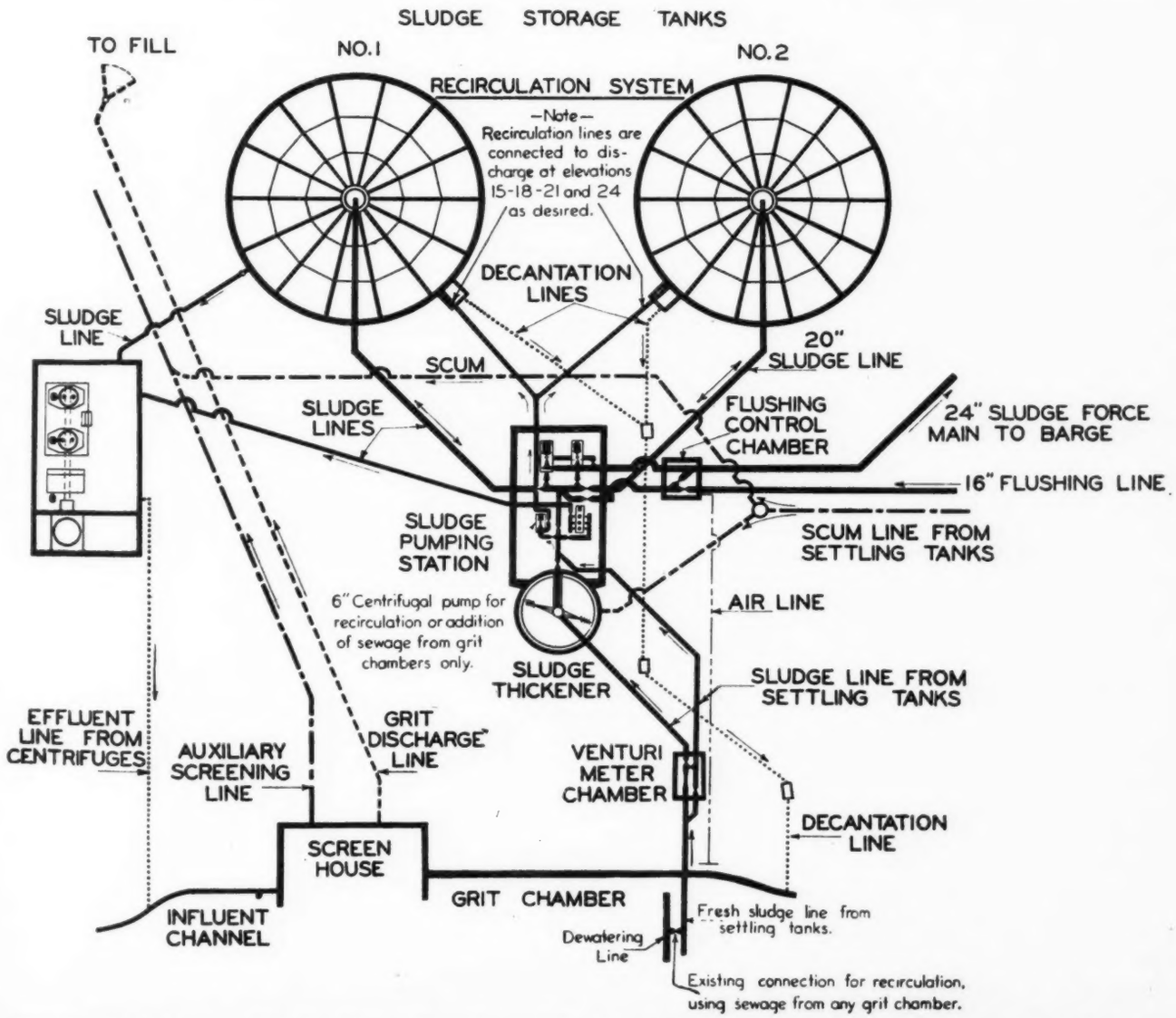
Inasmuch as the schedule of loadings is dependent upon operations of the owners of the dock, the commitments of the barging contractor, the amount of sludge in storage, the rate of accumulations, weather and the tides, it can readily be imagined that the loadings may be set for either day or night—and, such is the case. Because of the comparative infrequency of the loading operations and to cause the least interference with routine plant operation, men from the regular sewer maintenance force instead of men from the plant are used to handle the placing of the wooden floats at the dock, the mooring of the barge, the erection and handling of the 20 foot long 12 inch diameter rubber hoses and connections and other matters pertaining to the loading. Signals and communications with the plant and men at the pumps are by telephone or automobile as required.

Disposal of Sludge at Sea

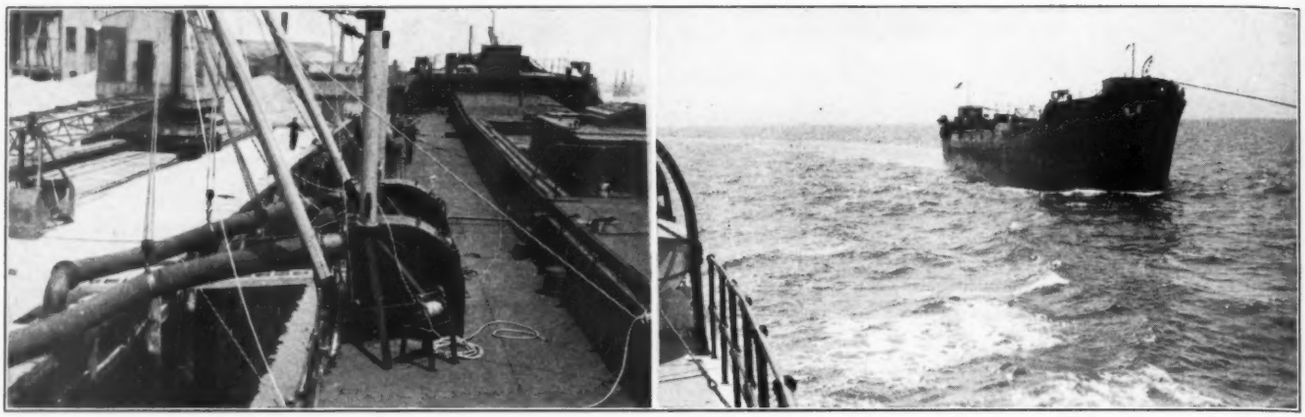
The disposal of sludge at sea has been practiced for many years in this country and abroad. In the metropolitan area the Passaic Valley Sewerage Commission has been using this method for about 18 years; the City of New York and the Joint Meeting about 4 years each.

Many people uninformed on the subject jump to the conclusion that the disposal of sludge at sea is a nuisance and is a more or less dangerous practice from the standpoint of public health. For concrete information as to whether or not such nuisance or danger to public health actually existed as the result of the disposal of sludge at sea, a recent survey was conducted. In May, 1938, an investigation on this subject was carried out under the joint auspices of the Department of Public Works, New York City; the Passaic Valley Sewerage Commission (N. J.), the Joint Meeting of municipalities in Essex and Union Counties (N. J.), and the Supervisor of New York Harbor.

Some 25 square miles in the vicinity of the sludge dumping grounds was surveyed between April 27 and



Arrangement and Layout of Sludge Storage Decanting and Conditioning Tanks, and Pumping Facilities.—Elizabeth Plant.
(An experimental demonstrating plant for sludge dewater ing with American Centrifugals is indicated at far left.)



Loading The Barge In-bound

Capacity 3,500 tons of liquid sludge; length 250 ft; draft 21 ft. when loaded.

May 7, 1938, for the determination as to what the conditions were on days when sludge was disposed of and on days when it was not. Laboratory tests were made on 142 samples from the area with the following summarized table of results:

Summarized Table of Survey Results

	Clear Sea Water (No Sludge Effects)	Average of All Samples Taken May 2nd-7th.
Suspended solids	5 p.p.m.	5.02 p.p.m.
Dissolved oxygen	9.5 p.p.m.	9.5 p.p.m.
Biochemical oxygen demand	.7 p.p.m.	.9 p.p.m.
Bacteria present	12 per c.c.	12 per c.c.

Examination of the above will indicate at once how favorably the affected area compares with that not affected by sludge discharge and how insignificant the effects of concentrated sludge discharge are when such a magnitude of dilution is available. Quoting briefly some conclusions from the joint report following this survey:

(a) "The usual condition of the area of waters is not indicative of continuous pollution or contamination, and no condition of nuisance exists."

(b) "The after effects of sludge dumping do not persist for long periods or over a widely spread area."

(c) "The observations made during the investigation indicate that the most disagreeable effects from the dumping of sludge arise at the time of dumping and in the spot where the dumping is taking place. Sludge, odors, and floating matter disappeared quickly and did not travel far. The waters in the area which was under examination quickly regained a normal condition after each dumping, and the laboratory data support these conclusions and demonstrate that the waters in the dumping area do not show signs of grease or persistent pollution."

Costs of Sludge Disposal at Sea

It probably will prove of interest to those who have to do with other methods of sludge disposal to have some information as to the costs involved in the disposal of sludge at sea.

For purposes of comparison, therefore, the following summary of costs for complete disposal are presented:

For the year of 1940—The Joint Meeting Plant

1. Dock rental and rights of way	$ 2,400.00
2. Wharfage fees ($50.00 per load)	1,150.00
3. Overtime dock charges	655.00
4. Labor (pro-rated according to time spent)	1,500.00
5. Electric power in loading	300.00
6. City water used for sluicing	50.00
7. Tonnage (80,545 at $0.245 per ton)	19,733.50
	$25,788.50

This, it will be seen, amounts to 32 cents per ton of sludge in the barge for the 80,545 tons disposed of. Since the average of all of the composite samples taken during loadings in 1940 was 8 per cent solids, this is equivalent to $4 per ton of dry solids disposed of.

It may be mentioned that the new rates which are to apply for the next 4 years will be about 9 cents per ton higher than the above. This will in effect cause about a 25 per cent increase in sludge disposal costs and will probably bring the costs per ton of dry solids to $5. Efforts towards improvement in concentration and in methods of handling will become just that much more necessary and desirable to hold down disposal costs, and the operating staff has taken up the challenge.

Doubling the Life of Conveyor Belts*

The accompanying sketch shows how conveyor belts commonly wear —on one side. Most of the wear usually occurs during the process of loading and when the material is loaded on one side, that is where the belt wears, as shown in the sketch.

To double the life of one of these belts simply turn it through 180 degrees—that is, turn it end for end. The material being loaded will then strike and wear the unworn or "good" side and the belt need not be discarded until both sides are worn sufficiently to justify it. It is obvious, then, that there is an advantage in *not* loading a belt in the center, because turning such a belt through 180 degrees to increase its life will do no good and the center-loaded belt will last only about one-half as long.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

EXPERIENCES AT NEW HAVEN, CONN.

(A Discussion)

By C. A. EMERSON, JR.
Consulting Engineer
NEW YORK CITY

FOR a period of approximately nine and one-half years extending from February, 1931, to July, 1940, sludge from the plain sedimentation tanks of the East Street Sewage Treatment Plant in New Haven, Conn., was dumped into the waters of Long Island Sound as a method of final disposal.

Experiments covering a period of several years prior to the design of the plant in 1930 had demonstrated the almost continual presence of copper in the sewage, in sufficient quantities to preclude normal digestion of the organic solids. This high copper content was due to the discharge of spent brass pickling liquor by some of the large industries in the sewer district, and had it not been possible to dispose of the sludge by dumping, it is unlikely that the treatment plant could have been constructed at that time, for no method of sludge disposal applicable in a congested district other than digestion and air drying was then available.

Permission was secured from the Federal and State Governments to discharge sludge on an area approximately one mile square situated about eight and one-half miles southeast of the mouth of New Haven Harbor and twelve miles from the treatment plant, where there is a water depth of about 75 feet. The site was well removed from oyster beds and off the route of steamer lines.

Sludge drawn from the plain sedimentation tanks was pumped to four elevated steel tanks for decantation. These tanks were cylindrical steel tanks of the conventional water works type, with a capacity of 20,000 gallons each, and were equipped with an eight-inch diameter sludge discharge valve in the hemispherical bottom and a three-inch diameter floating supernatant liquor draw-off pipe. They were constructed on the wharf adjacent to the settling tanks and at a suitable elevation for discharge of sludge by gravity to the sludge barge.

The average daily flow at the East Street Plant is approximately nine million gallons, and sludge drawn from the settling tanks has a solids content of about one and one-half per cent, which, by decantation, was concentrated to ten per cent solids without difficulty. The supernatant ranged from 500 p.p.m. to 1,000 p.p.m., and was carried by piping to the inlet channel of the settling tanks.

The sludge barge had four covered rectangular steel deck tanks of 20,000 gallons capacity each, and sludge was discharged through a swivel pipe twelve inches in diameter serving each tank through flexible connections. The barge was towed by a tug to the disposal site, a round trip requiring from five to seven hours, and from twenty-four to twenty-six trips a year were necessary. The city was required to maintain a buoy at the dumping site and to carry a federal inspector on each trip.

Generally speaking, the method of disposal was reasonably satisfactory. However, it was subject to occasional interruptions due to ice-locking of the harbor or freezing of the sludge in the decantation tanks. During 1937, one interruption lasted for six weeks and for part of this time it was necessary to bypass the plant. Occasional complaints were received of oil sleek and floating solids in the vicinity of the disposal area.

Most of the difficulties due to freezing of solids could have been eliminated by providing a heated enclosure for the decantation tanks. This, however, together with provision of a self-propelled tanker which would have been better able to buck the harbor ice in winter, represented a large investment which the city felt was not justified in view of the rapid advances being made during the past few years in conditioning and incineration of raw sludge.

Accordingly, in the fall of 1938, it was decided to install a sludge dewatering and incineration plant. This was completed and put in operation in July, 1940, the barge was sold, and the disposal of sludge by dumping became a matter of sewage treatment history so far as concerns New Haven.

PASSAIC VALLEY COMMISSION EXPERIENCE

(A Discussion)

By J. RALPH VAN DUYNE
Chief Engineer
PASSAIC VALLEY SEWERAGE COMMISSION
NEWARK, N. J.

THIS subject, "The Disposal of Sewage Sludge at Sea," is really quite up my alley, as the slang expression goes, for during the past fifteen years the Passaic Valley Sewerage System has sent over five million tons to sea.

Our system has been in operation since the summer of 1924 and serves twenty-two municipalities in the metropolitan district of New Jersey bordering the Passaic River and extending from Paterson on the northerly extremity to Newark on the southerly.

A main intercepting sewer stretches from end to end of the system, a distance of twenty-one miles, and is located on the west side of the Passaic River—nine river crossings and branch intercepting sewers collect and transfer the sewage from the easterly side of the river to the main interceptor on the westerly side.

The Plant

At the downstream end of the main interceptor on the Newark meadows the sewage enters the Newark Bay Pumping Station, where it is lifted forty feet into plain sedimentation basins.

Here the sludge is settled out and the sewage then passes through a five mile pressure tunnel and is discharged in the deep channel of New York bay at a point approximately two miles below the Statue of Liberty and within the boundary line of New Jersey.

The sedimentation basins are constructed with hopper bottoms. The hoppers are twenty-four feet square on top and four feet square on the bottom and have a vertical depth of thirteen feet; above the top of the hoppers is a clear waterway twenty-one feet deep. There are one hundred and sixty-eight hoppers in all. Each hopper has a ten inch sludge pipe passing out of the bottom, which in turn connects with a twenty inch sludge main which extends two thousand feet to the westerly shore of Newark Bay. A bulkhead three hundred and thirty feet long, with a depth of water of thirty feet at mean tide, enables the sludge boats to tie up and receive their load of sludge.

The Barges

The sludge boats in use for the past six years consist of two barges divided into compartments and hold approximately three thousand five hundred tons of sludge per barge. They are loaded by means of two ten inch flexible pipes connected to the end of the twenty inch sludge main. One pipe discharges into a hole in the side of the barge and the other pipe, after the barge is partially loaded, discharges into hatchways on the top of the barge. There is one hatchway for each compartment in the barge and after the barge is filled the hatchways are sealed down with water tight tops.

In loading the barges the hydrostatic head from the basins is augmented by a ten pound air pressure discharged through a four inch pipe into the upstream end of the twenty inch sludge main.

The time required to load three thousand five hundred tons is from six to eight hours.

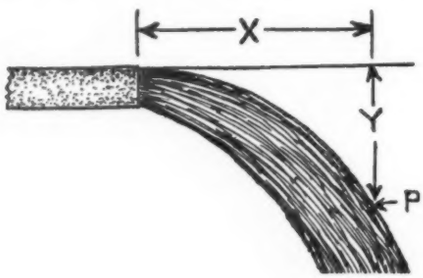
The barges are towed from our bulkhead at Newark Bay a distance of twenty-eight miles out to sea to the sludge dumping grounds designated by the Federal Government.

Upon reaching the dumping grounds the barge is towed slowly around in a circle of approximately one thousand feet in diameter and the sludge is pumped overboard with two sixteen inch centrifugal pumps. It takes about two hours to discharge the cargo into the ocean.

Our sludge is being handled today by Merrit-Chapman & Scott Corporation under a five year contract and costs $0.1944 per wet ton.

DETERMINING FLOW FROM A HORIZONTAL PIPE

THE quantity of water or sewage flowing from a horizontal pipe, as shown in the accompanying sketch, can be determined with surprising accuracy by simply measuring the horizontal distance X and the vertical distance Y to any convenient point P as indicated by the dimension lines on the sketch.



This is possible because of the well known law of physics which tells us that a horizontally projected body falls at precisely the same rate as does a body that is dropped vertically from a state of rest.

The distance Y is measured in inches, therefore $Y/12$ = ft.

The distance X is measured in inches, therefore $X/12$ = ft.

t = number of seconds;

v = velocity of the liquid in ft. per sec.;

It is plain now that $X/12 = vt$ whence $t = X/12v$,

Now we introduce the well-known falling body formula $s = \frac{1}{2}gt^2$ where s is the space through which the body falls, in feet;

g = acceleration due to gravity, or, 32.16

t = number of seconds of fall.

Substituting $Y/12$ for s we get $Y/12 = \frac{1}{2}gt^2$ and from it we find

that $$t = \sqrt{\frac{2Y}{12g}}$$

We have already found, above that $t = x/12v$, which enables us to eliminate t and from our new equation we solve for v and get

$$v = \frac{1.16\ X}{\sqrt{Y}}$$

So now, knowing the velocity of the water at the mouth of the pipe it is not a difficult matter to determine the quantity flowing, knowing the inside diameter of the pipe also. For instance,

12v = the velocity of the water in inches per second;

12vA = the cubic inches of water flowing per second, where

A is the cross-sectional area of the interior of the pipe in square inches;

A, of course, is equal to $0.7854D^2$ where D is the inside diameter of the pipe in inches.

From these facts we derive the formula

$$G = \frac{2.84\ D^2X}{\sqrt{Y}}$$

where G = gallons of water flowing per minute.

But as all hydraulic engineers know, the flow of water is not "absolutely perfect." Owing to the friction between the walls of the pipe and the water it is necessary to multiply formulas of this type by a constant, and in this instance it appears that 0.90 is best for general service. As a result we have this final formula

$$G = \frac{2.56\ D^2X}{\sqrt{Y}}$$

where, as already stated,

G = gallons of water flowing per minute

D = inside diameter of the pipe, inches;

X = horizontal distance to point P, inches;

Y = vertical distance to point P, inches.

For example, if D is 2 inches, X is 20 inches, and Y is 25 inches, it will be found that the flow is 40.96 gallons per minute.

Short Cut.

A short cut that will make your work easy is to choose a point P that is down a distance 9 inches, 16 inches, 25 inches, or 36 inches, etc., because their square roots are 3, 4, 5 and 6, respectively. In that way it will not be necessary for you to refer to tables of square roots or to arduously extract a square root by "longhand."

Contributed by W. F. Schaphorst, M.E.

SOCIAL SECURITY AND RETIREMENT PLANNING*

Legislation Affecting Municipal Employees

By DALE L. MAFFITT
Gen'l Manager
DES MOINES WATER WORKS
DES MOINES, IOWA

THE need for a program of comprehensive nation-wide social security has been increasingly recognized for a number of years, and it was in August, 1935 that it first became a matter of national legislation. The Social Security Act adopted at that time provided for old age and survivors' insurance, administered by the federal government, and offered the states federal cooperation in nine federal-state programs — unemployment insurance; aid to needy aged, needy blind, and dependent children; services for maternal and child health, child welfare, the treatment of crippled children, public health, and vocational rehabilitation.

The part of this legislation in which we as an employed group are interested is that which has to do with old age and survivors' insurance. In the original bill as passed in August, 1935, and which became effective January 1, 1937, more than 43,900,000 accounts were established for industrial and commercial workers. But these did not include the more than one million municipal employees of the nation. Specific exemptions to participation in benefits of the Act as listed under Section 210 (b) include "services performed in the employ of states, a political subdivision thereof, or an instrumentality of one or more states or political subdivisions." This means the most water works employees receive no benefits from the legislation.

The Amended Act of 1939

The original Social Security Act placed upon the Social Security Board the duty of studying social needs and legislation and the further duty of making recommendations for progressive development. As a result, in August, 1939, on the basis of administrative experience and study, a bill was passed by Congress amending the Social Security

The Author

Act. This was an attempt to make the Act more nearly meet the needs of people as a whole.

The major changes made by this amendment were: provision for increased federal grants for public assistance and for health and welfare services; changes in the taxing provisions relating to old-age and survivors' insurance and unemployment compensation, which were designed to bring about substantial savings for employers and workers; and liberalization of the old-age insurance plan, established by the original law, to provide earlier and more adequate payment of benefits and to extend monthly benefits not only to the worker but also to his family, including supplementary benefits to aged wives and dependent children of retired workers, and monthly benefits to surviving widows, orphans and dependent parents.

In general the original Act covered all industrial and comercial employment in the United States. Under the amendment the principal new inclusions were employees of national banks, state banks which are members of the Federal Reserve System, and building and loan associations; employees on American vessels; and workers over the age of 65.

The Pros and Cons of Extending the Act to Cover Water Works Employees

Experience and research in the future will undoubtedly offer further suggestions for improvement in national legislation toward social security for the American people. It is in these future improvements that water works and sewerage men should be concerned. There should be some plan evolved whereby our employees may be assured of security in their old age. Inclusion in the national program would seem at first glance to offer the ideal solution, but there are a number of problems involved which must be worked out before such legislation becomes a reality.

Widespread discussion among public employees, of the proposed plan for extension of the old-age and survivors' insurance provisions of the Social Security Act to employees of states and political subdivisions thereof, have given rise to protests from the participants in retirement systems now in operation in many communities.

With this problem particularly in mind the Municipal Finance Officers' Association arranged a conference with representatives of the Social Security Board and the Federal Security Agency. This conference was held in Washington, D. C., on November 25, 1940, and the intent of the meeting was to discuss informally the effects of extending the Social Security Act to public employees.

An account of the material discussed is outlined in Minnesota Municipalities, March 1941. It was agreed that the objectives to be accomplished by the extension of federal insurance coverage to state and municipal employees were as follows:

Desirable Objectives and Possible Plans

Primary objectives: (1) To provide continuity of protection for these employees who transfer from one employment to another during their working lifetime. (2) To provide some sort of protection for approximately one and a half million public employees not now covered by any retirement system. (3) To provide survivors' benefits for those having no such survivorship protection.

Secondary objectives: (4) To avoid any reduction in existing protection, such as old age or disability benefits, as provided by existing systems. (5) To prevent unnecessary duplication

*This paper, presented before the 61st Convention of the American Water Works Association, is here reproduced by permission of the Association. The author is chairman of the Association's Committee on Social Security Leigslation and Retirement Plans.—Ed.

of protection in two or more systems and to adjust the differences between systems so that no individual will be without adequate protection.

Several possible plans for meeting these objectives were discussed. One, as proposed in the Wagner bill, would provide compulsory coverage for all state and municipal employees regardless of existing retirement systems. This would accomplish the three primary objectives. Objections to this plan were the increased expense where retirement systems are now in existence; the possibility that such federal legislation would be unconstitutional; the delay entailed in state and local legislation necessary to legalize taxes and adjust existing systems; and administrative difficulties due to constant change in state and local officials.

The second plan discussed was the Wagner bill amended. This would provide compulsory coverage for all state and municipal employees not now members of an existing system. and would accomplish only the second major objective. This plan might be unconstitutional and would be difficult to administer. To each of the above plans is the political objection of forcing a federal insurance program on self-governing state and municipal units.

The third plan discussed was that of voluntary agreements. This would extend coverage by voluntary agreements between the federal insurance system and states or minor political units. Here again there would be difficulties in administration and inequality of benefits.

It was evident in the discussion that there was considerable opposition to any plan of extension of the Social Security Act that would not permit the preservation and perpetuation of those systems already in existence. A committee was appointed to follow developments on this question and to attempt to work out a satisfactory plan which would bring about the extension of the Social Security Act on a basis acceptable to both covered and non-covered groups of public employees, as well as to the Social Security Board.

This committee held a meeting in Chicago, Illinois, on February 15 and 16, 1941, at which were also present D. C. Bronson, Assistant Actuary of the Social Security Board, and Benjamin Kendrick of the Bureau of Old Age and Survivors' Insurance. Quoting from the report of the committee as stated in the special news letter of the Municipal Finance Officers' Association, March 16, 1941, "The committee viewed the question of coverage for the public employees in its broadest sense, from the standpoint of both the covered and non-covered groups. It was particularly concerned with the effect of any such legislation on the states and local governmental units because of the problems that would arise from any plan of extension which did not allow sufficient time for: (1) the required budget adjustments to meet the additional costs; and (2) amendments to existing constitutions, statutes or charters.

"It also regarded with some apprehension the disturbing effects on personnel policies of local governments which any extreme departure and sudden change in the existing retirement provisions would bring about, because of the fact that retirement provisions of many communities have been formulated with a view to realization of certain definite personnel objectives.

"The members of the committee took cognizance of the possibility that any plan of extension of the Social Security Act which would create a parallel system of benefits and salary deductions, with resulting increases in costs, would be looked upon adversely by the local governmental authorities, and might prove decidedly injurious to the existing systems.

"The question of constitutionality was considered of great importance, and one that could not be disregarded in a study of the problem, and it was the opinion among the members of the committee that any plan of extension which involved that question should be avoided."

Recommendations of the Committee

The committee reviewed the several methods of extension as proposed at the Washington conference and as developed during the discussions, and in making its recommendations was influenced by the following considerations:

"That the problem of the public employee in relation to coverage under the Social Security Act is in many respects different from that of the industrial worker.

"That appropriate retirement provisions should be made for all non-covered groups of public employees.

"That continuity of protection for those employees who transfer from one employment to another during their working lifetime, and the provision of survivors' benefits for those having no such survivorship protection, are desirable objectives.

"That the perpetuation of the existing systems must be definitely provided for in any plan of extension of the Social Security Act for the protection of the accrued rights and future benefits.

"That a federal plan alone, in its most complete form would still fall short of meeting the requirements of certain occupations for retirement ages lower than the prescribed standard, and in dealing with special hazardous occupations as well as with economic conditions peculiar to the various localities.

"That by giving each local community the privilege of choice with respect to participation in the federal system, sufficient elasticity will have been provided so as to afford protection to the existing local plans and make it possible for non-covered groups to secure a minimum coverage and supplementation."

Voluntary Plan Favored for Reasons Cited

The committee recommended that "if the Social Security Act is to be amended to include public employees under the Old Age and Survivors' Insurance provisions of the said Act, such inclusion be made voluntary on the part of the states and political subdivisions thereof; that this can best be accomplished through the medium of voluntary agreements or compacts between the states and the federal government, whereby the states would enact permissive legislation granting to their own employees and the employees of their political subdivisions the privilege of participating in the benefits and obligations of the Social Security Act, provided that each political subdivision be given the right through its appropriate legislative body to exercise its choice in participating in the agreement made by the state."

Advantages of Federal Plan Analyzed

John J. Corson, Director, Bureau orf Old-Age and Survivors' Insurance, Federal Social Security Board, in an article "Social Security and Municipal Employees" printed in Minnesota Municipalities, March, 1941, states the problems in much the same way. However, it is his conclusion that the advantages to be gained for municipal employees in general extension of the federal system of old-age and survivors' insurance to all public employees would greatly out-weigh the disadvantages.

As advantages he points out that it would provide retirement incomes for that 50 per cent or more of municipal employees who now have no

such protection. The survivors' insurance providing monthly benefits for children under 18, widows, and aged parents, would give the essential protection that not more than one municipal worker in ten now has. Under the federal system the worker would have a continuity of security if he changed jobs—either changing to another branch of municipal service or going into private industry.

One problem to be solved is the question of constitutionality. Mr. Corson suggests that one way to determine this is for Congress to extend the coverage to state and municipal employees and through a test case have the courts decide whether or not it is constitutional.

Assuming it would be constitutional, the first actual effect would be to force states and municipalities to make adjustments in existing retirement systems. This would require careful study and considerable work on the part of those concerned, but this is not an impossible barrier. A great number of private industrial concerns had established pension systems before the Social Security Act was passed. These organizations have adjusted their systems to provide supplementary benefits for employees and to assure them of no loss of benefits accrued up to the time of adjustment.

Cost to Cities

Then there is the big question of the additional burden to be placed upon the taxpayer to provide this retirement insurance for all state and municipal employees. Mr. Corson thinks that the cost would be less than one per cent of the total expenditures of these municipalities, and thinks that with adjustments of existing systems, the cost might be even less. There is still the question of administration. That, however, is a problem that enters into any municipal enterprise.

In conclusion he points out "that benefits under the old-age and survivors' insurance system are not geared to provide luxury, but are designed merely to afford a basic minimum of security, a floor of protection. . . . This essential protection is important not only to . . . individuals, but also to the society which has assumed the obligation of caring for those persons who are without other means of support through relief and assistance."

What the Benefits Amount to

In view of the possibility of amendment to the Federal Social Security Act to bring employees of state and local governments under the provisions of the old-age and survivors' insurance title, it might be well to point out briefly what this insurance is.

The tax is 1 per cent each upon employers and employees through 1942. From 1943 until 1946 the rate will be 2 per cent upon each; from 1946 to 1949, 2.5 per cent; and thereafter 3 per cent. The employee's per cent of compensation is deducted by the employer and paid with the employer's share.

In order to qualify for monthly primary insurance benefits a worker must be 65 years of age or older, must be fully insured, and must have filed application for benefits. A worker is fully insured if he has a certain number of "quarters of coverage," depending on the length of time he has been in employment covered by the system. A "quarter of coverage" is a calendar quarter year in which the worker has received $50.00 or more in wages for covered employment. In general, a worker is "fully insured" when he has "quarters of coverage" equal to half the quarters elapsing after 1936 up to the quarter in which he reaches 65 years of age or dies. A minimum of six quarters of coverage is necessary. After a worker has 40 quarters of coverage he is "fully insured" for life, regardless of whether or not he is in covered employment thereafter.

The monthly benefit which a worker may receive on the basis of his or her own wages is called a "primary insurance benefit." The primary insurance benefit is computed by adding 40 per cent of the first $50.00 of the worker's average monthly wage, and 10 per cent of the amount by which his average monthly wage exceeds $50.00, but does not exceed $250.00. The total of these two amounts is increased by 1 per cent for each year in which the worker was paid wages of $200.00 or more for covered employment. For example, suppose a man has been receiving an average monthly wage of $100.00 since the beginning of 1937 and chooses to retire when he reaches the age of 65 in January, 1942. He would receive $26.25 a month—40 per cent of the first $50.00 of his average monthly wage, plus 10 per cent of the remaining $50.00, plus an additional 5 per cent for 5 years' employment; or $20.00 plus $5.00 plus $1.25, making a total of $26.25.

A wife who is 65 years of age receives one-half of the amount received by her husband, unless she has been in covered employment and qualifies on her own account, in which case she receives whichever is the larger amount. Widows and children are also provided for.

Iowa Passes Special Enabling Legislation

In line with the recognized need for security for workers in the utility fields, the Des Moines Water Works succeeded in getting a bill passed by the Iowa Legislature in its 1940-1941 session which authorizes boards of water works trustees of municipally owned water works in certain cities to procure group insurance for employees of such water works, to establish a plan and fund for such purpose, and to administer the same.

Under this authorization the Des Moines Water Works is in a position to establish a group insurance fund to be created from the following sources: contributions from employees who elect to participate in the plan, and contributions authorized by the board of water works trustees from the income from operation of such water works in amounts not to exceed the aggregate amounts assessed against and collected from employees who elect to participate in such plan. Contributions to this fund by the board of water works trustees and expenses incurred in administration of the plan shall be considered to be operating expenses of the water works system.

Participation in such group insurance is to be optional with all employees eligible to the benefits thereof as provided by the rules and regulations adopted by the board pursuant thereto. The board is authorized to contract with any legal reserve insurance company or companies authorized to do business in the state of Iowa for group insurance for its employees, which may include life, health, hospitalization and disability insurance.

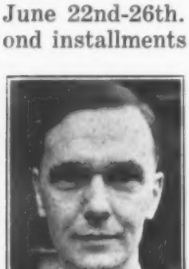
We feel that this is definitely a step forward in our effort to achieve social security for our water works employees. The next goal is old-age insurance. If the provisions of the Federal Social Security Law should be broadened to include employees of municipalities it is probable that the states will have to approve the amendment to make it constitutional.

If the coverage of the Social Security Act is not extended to municipal employees, then we must organize our own plan. In either case, for the Des Moines Water Works in particular, we think that this group insurance authorization is the first approach to the final solution.

A. W. W. A.
TORONTO CONVENTION TOPICS

Digests of Papers and Discussions

THIS constitutes the final installment of the report covering A.W.W.A.'s 61st Annual Convention held in Toronto, Canada, June 22nd-26th. The first and second installments ran in our July and August issues. The report in our August issue dealt with water treatment topics, including all papers presented before the Water Purification Division. The present report covers papers presented before the Plant Management Division and the Finance and Accounting Division.



Division Chairmen 1940-'41

Management
Louis S. Vance, Chief Engr. and Supt., Louisville, Ky.

Finance
John C. Flanagan, Registrar and Asst. Secy., St. Paul, Minn.

Session on Metal Protection

(L. R. Howson, Presiding)

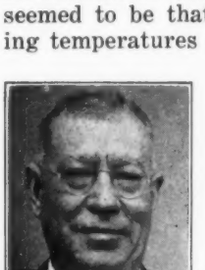
"Experiences With Cathodic Protection of Water Tanks" by J. Clark Keith, Gen'l Mgr., Windsor Utilities Commission, Windsor, Ontario.

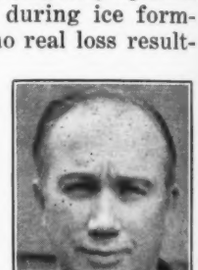
Mr. Keith's report on experiences with the cathodic method of electrically protecting steel water tanks and submerged metallic parts against corrosion and tuberculation, was based on a survey of the literature and more recent information secured from users of the method and from companies installing cathodic protection equipment. There are now in use better than 800 installations, according to statistics, and an added 200 going in.

Mr. Keith, stating that an active surface of submerged steel has a *positive* potential of something less than 2 volts, explained that it was only necessary to overcome this tendency of the steel to enter into solution, and form rust, or tubercules, by reversing the natural galvanic current flow by imposing a *negative* potential of 2 volts or more on the tank surface at the water face. In addition, the all important conductivity of the water would determine the total voltage required to insure current flow from the electrode, through the water, to the metallic area to be protected. In the process it had been found necessary to maintain a current flow of 3 amperes for every 10,000 sq. ft. of submerged metal surface to be protected. These two requirements appeared to be basic.

Concerning material for the anodes suspended in the water, from which the current flows to the tank wall which becomes the cathode, the controversy as to the relative merits and longevity of anodes of stainless steel vs. carbon or graphite, continues unabated between the purveyors. No data of sufficient merit had been obtained to clarify the picture.

As to ice damage to hanging electrodes, from vertical movement and turning of the ice cake in tanks, a number of experiences and opinions were obtained from users questioned. The ice problem seems to be about the only factor of concern to all but a very few users of the system. Considering the merits of the method, the nuisance of removing the electrodes during periods of ice trouble expectancy was considered by a number a relatively minor disadvantage. Attempts at electrical heating of electrodes had not been successful in severe weather. In cases involving ground water supply (53° F. and higher) replacement of roughly 33 per cent of the tank contents daily by rise and fall had prevented serious ice formation. The majority opinion seemed to be that during ice forming temperatures no real loss resulted from removing the anodes, because galvanic corrosion slows up so markedly at freezing temperature as not to be of real moment. The ice skin in itself is an insulating film against oxidation and the protective hydrogen film stays intact also. Careful observations by a few had indicated no winter corrosion during periods of removed anodes.





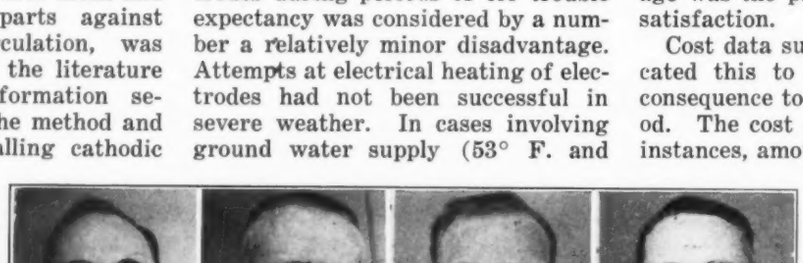
Division Officers

Management
G. L. Fugate, Chief Engineer Houston, Tex. (New Vice-Chm'n)

Finance
Dale F. Maffitt, Genl. Manager, Des Moines, Ia. (Past Chm'n and Director)

A prominent tank manufacturer reported results of a survey of owners of their tanks having cathodic protection. In this 73 per cent reported complete satisfaction; 14 per cent not completely satisfied; 13 per cent dissatisfied. Here again ice damage was the principal cause for dissatisfaction.

Cost data supplied Mr. Keith indicated this to be a factor of least consequence to those using the method. The cost of the installation, in instances, amounted to less than that of one cleaning and repainting job. In the smaller installations the initial expense might be equal to two or even three paintings, but there were always mentioned the offsetting out of service hazard, inconvenience and added cost of pumping against a closed system for



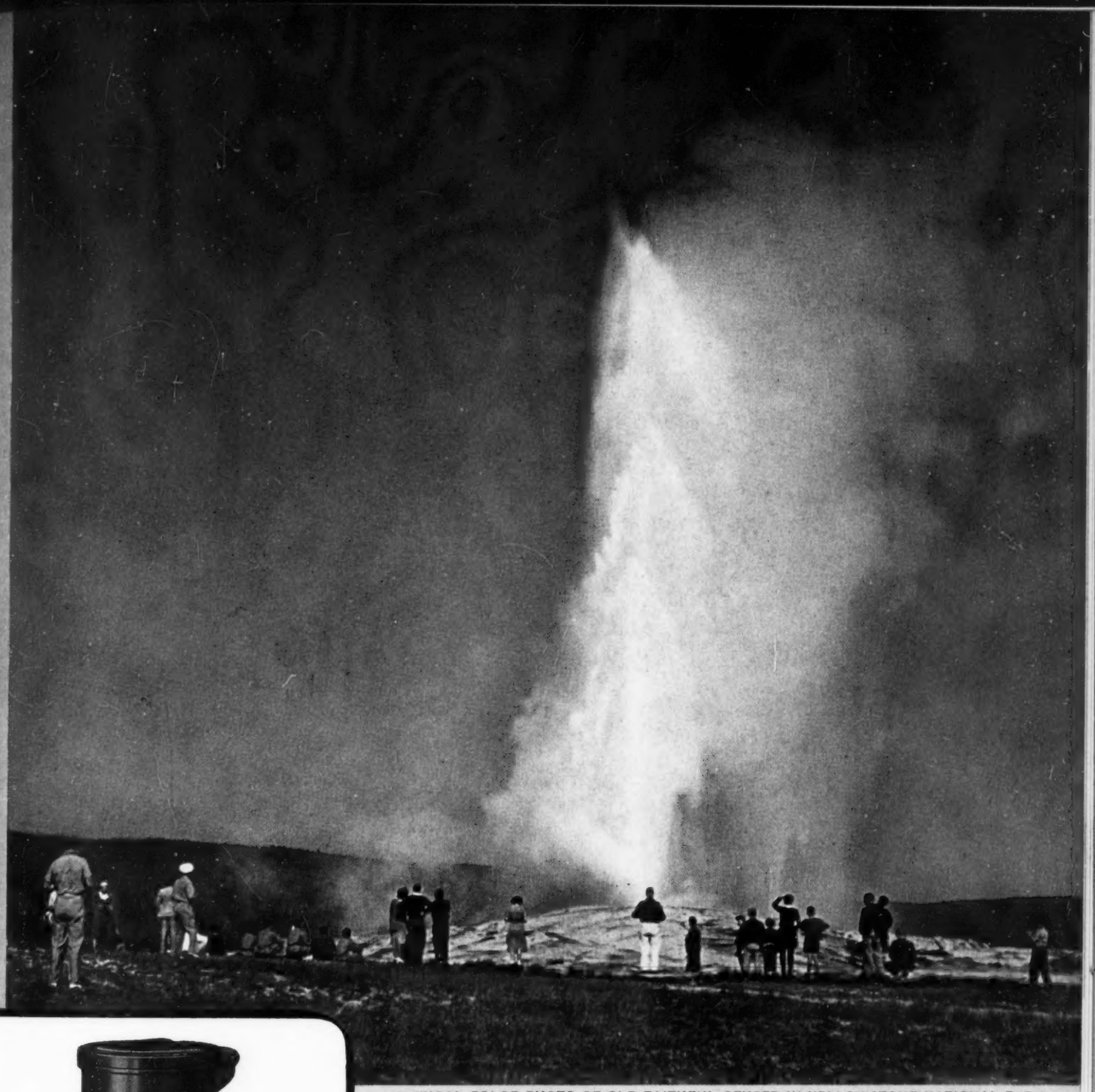
Programmers

Carl A. Eberling, Supt. of Water, Cincinnati, O.

W. R. Ladue, Chief Engr. and Supt., Akron, O.

L. A. Bergman, Director of Water, Buffalo, N. Y.

Kenneth K. King, Director of Water, Kansas City, Mo.



NATURAL COLOR PHOTO OF OLD FAITHFUL GEYSER IN YELLOWSTONE NATIONAL PARK

Always Dependable

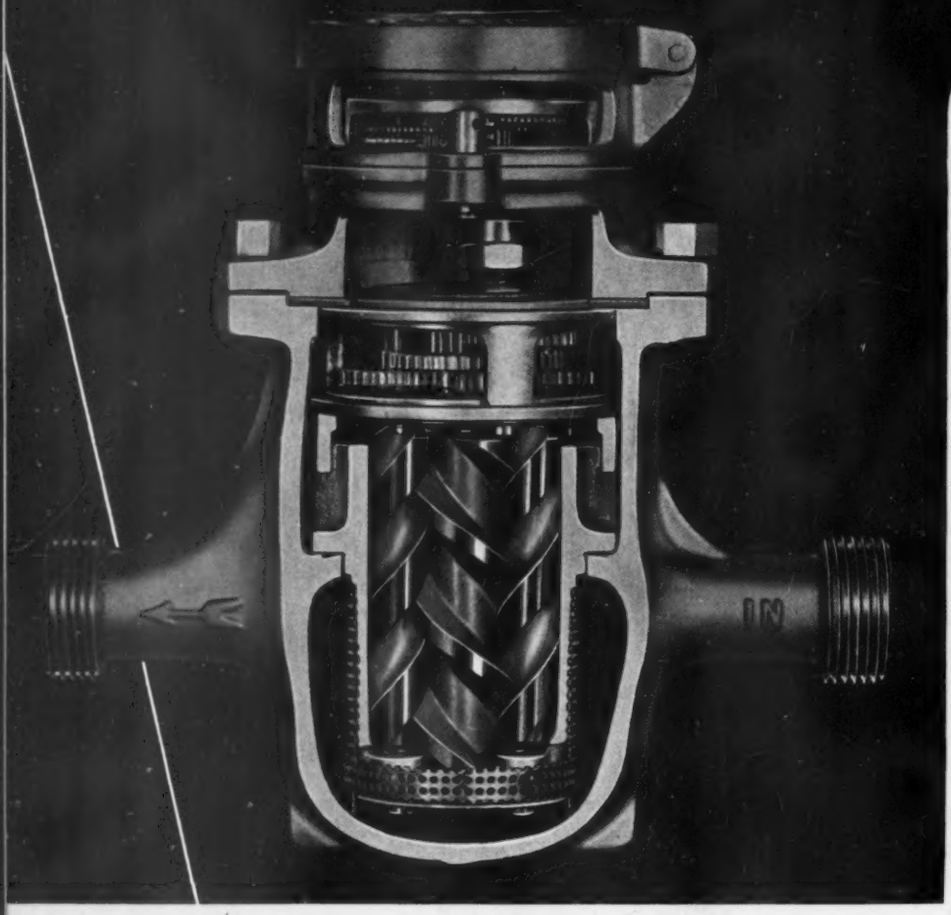
PITTSBURGH IMO METERS

GREATER dependence is placed upon water meters than any other single factor in the operation of a water plant. Meters are installed to fairly assess charges for the water consumed by each service. The operating revenue for the entire department depends on the performance of these meters. Successful operation requires meters that are most accurate; that always record the low flows; that are long lived and are inexpensive to repair; that never become noisy.

Pittsburgh IMO Meters have a well-earned reputation for thorough dependability. They can be trusted to produce the maximum revenue from any and all services, even after millions of gallons have been measured. They always operate quietly, last longer and require fewer repairs. They cost less because they measure more.

PITTSBURGH IMO METERS

WEAR IN WHERE OTHERS WEAR OUT



THE INSIDE STORY OF PITTSBURGH IMO METERS

REGISTER—Nickel-plated throughout, equipped with dust rings, spindles work in hard rubber bushings; all to assure accuracy, long life and low maintenance cost. All registers have the large red center hand for accurate proving and detection of leaks. Both circular and straight reading types, indicating either gallons or cubic feet are available.

FROST-PROOF OR STANDARD BOLTS—For colder sections of the country, the IMO is furnished with frost-proof bolts that break in the event of freezing and permit the case to separate without damage to meter parts.

ENCLOSED INTERMEDIATE GEAR TRAIN—Extreme care has been exercised to produce a smooth running, long wearing gear train. All spindles operate in hard rubber bushings. Gears are of hard, special gear bronze. The gear box is cast from a special non-corrosive bronze, and upper and lower parts are held together by three screws, making assembly or disassembly a very easy matter.

STRAINER—Completely encircling measuring chamber, the IMO strainer has more area than is found in any other meter. It should be observed that the IMO will stand up longer than any disc meter, even if the strainer is omitted entirely because the water passes through the measuring chamber without turbulence.

MEASURING CHAMBER—The measuring chamber is cast from a special non-corrosive bronze alloy. Machining is held to extremely close limits at this point and the polished interior surfaces provide an ideal confining medium for the hard rubber rotors.

ROTORS—The rotors consist of three vulcanized hard rubber screws which mesh with each other and fit the bore of the measuring chamber. Water enters the measuring chamber from the bottom and, as it is forced upwards by line pressure, causes the rotors to turn from its path. The threads on the rotors act as a continuous piston which always moves in a forward direction. Water is not brought into rotation, but flows smoothly without turbulence or pulsation. The action is perfectly smooth and free from vibration even when operating at maximum flow rate.

QUICKLY AND EASILY ASSEMBLED

—The features described in the other panels explain the major parts which comprise the Pittsburgh IMO Meter. They can be assembled in the exterior case to form the complete meter in a few minutes' time and conversely the meter can be disassembled, while in the line if necessary, just as quickly.

PITTSBURGH EQUITABLE METER COMPANY

NEW YORK BROOKLYN DES MOINES MEMPHIS DALLAS TULSA CHICAGO BOSTON

MERCO NORDSTROM VALVE COMPANY
Main Offices, Pittsburgh, Pa.
NATIONAL METER DIVISION, Brooklyn, N. Y.

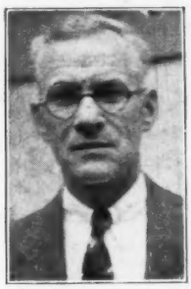
KANSAS CITY PHILADELPHIA SAN FRANCISCO LOS ANGELES SEATTLE HOUSTON COLUMBIA BUFFALO

Voted the George W. Fuller Award by their Sections

(Illinois)
Frank Amsbary, Jr., Superintendent, Champaign, Ill.

(Southwest)
V. M. Ehlers, Chief Engineer, Austin, Tex.

(Mo. Valley)
D. L. Erickson, City Engineer, Lincoln, Neb.



(Four States)
I. M. Glace, Consulting Engr., Harrisburg, Pa.

(Pacific N. W.)
Wm. P. Hughes, City Engineer, Lewiston, Ind.

(Ohio)
M. F. Hoffman, Commercial Supt., Cincinnati, O.

(Wisconsin)
Arthur P. Kuranz, Superintendent, Waukesha, Wis.

(Florida)
R. W. Reynolds, Manager, W. Palm Beach, Fla.

(New York)
R. G. Yaxley, Superintendent, Waterford, N. Y.

the periods of 5 to 7 days. Herewith we tabulate some of the representative cost figures for current used by the systems in use:

Tank Size (Gals.)	Current Rate (Cts./KWH.)	Total per Month
750,000	3.6	$1.22
350,000	3.6	1.29
250,000	..	0.75
110,000	4.5	0.80
50,000	2.85	0.98

One user with eight installations on tanks of 50,000 gals. and upwards reports current consumption averaging that of one 40 watt lamp per tank, stating that even if as much as $3.00 per month the method would be attractive economically.

"Experimental Studies of Tank Coating Materials" by J. O. Jackson, Chief Engr., Pittsburgh Des Moines Steel Company, Pittsburgh, Pa.

In a most pleasing style, Mr. Jackson presented an interesting review of the extensive studies made of mechanical and chemical methods of preparation of metal surfaces for applying protective coatings, and the relative merits of primers and protective coatings of many types and manufacture. It being impossible to reproduce here the large number of self-explanatory lantern slides in color, clearly revaling the history of various methods of surface preparation and coatings applied, this report will lack much that Mr. Jackson's presentation had in the direction of the truism that one picture is frequently worth thousands of words—especially so if the pictures are in true colors, as were Mr. Jackson's. As the result of these exhaustive exposure panel-tests, and field experience with tank interiors, Mr. Jackson's paper supplies a list of 10 recommended protective coatings to choose from, 6 of which are bituminous coatings applied hot.

Of considerable interest were the panel-test specimens, revealing sand-blasting to be a less satisfactory method of preparing surfaces for painting than wire brushing. The sand-blasted surfaces continued to rust beneath the coatings. Parkerizing failed to check weathering unless painted promptly after the acid pickling, and Bonderizing proved less satisfactory than Parkerizing. It was also proved that allowing the surface to weather-rust before applying protective coatings is bad practice. Further, that without an effective primer aluminum paint does not protect.

Mr. Johnson discussed the value of phosphoric-acid pickling of new plates and phosphoic-acid hand brushing of old work as being the best sort of preparation for good paint adherence.

Concerning cathodic protection for interior protection, Mr. Jackson said that he and his associates in Pittsburgh Des Moines Steel Co. had investigated the method and had become convinced that it constituted the most practical and best scheme of protection yet. His list of primers and 10 coatings most favored will serve as a valued guide for exterior metal painting in general, as well as for under water (or sewage) protection.

Cement-Lining of Water Mains in Place

This topic was covered in three papers reciting experiences at Akron, Toledo and Cincinnati, Ohio, with the cement lining of new and old water mains in place.

"Experiences at Toledo, Ohio"—by George N. Schoonmaker, City Manager, Toledo, Ohio.

Mr. Schoonmaker recited experiences in the lining of 5 miles of large diameter steel mains in Toledo, employing the "Centriline" method of machine application of cement mortar linings to pipe already laid, some being new and some old. The first project involved 3 miles of 48 inch Dresser- coupled steel line laid in 1937. The walls were wire-brushed by hand and the ¾ inch spaces between pipe ends, in the Dresser couplings, filled with hand-trowelled mortar before running through the "Centriline" lining machine. This machine spins mortar onto the pipe walls, through high impact centripetal force, from a spinning nozzle head. Rotating trowelling arms follow immediately to produce the de-

sired smooth surface of a continuous bore. This electrically driven lining machine and storage battery propelled mortar hauling buggy, traveling on rubber tired wheels, were inserted in the main through just two openings cut in the entire 3 miles of main. The thickness of lining is determined by the rate of travel of the machine. In this instance the specified average of ¼ inch (3/16ths minimum) was readily secured, with little variation from the ¼ inch.

At the end of each day's run the section lined was sealed by bulkheading off for 72 hours of curing, after 12 hours of such curing it being possible to walk on the lining without injury to it. Injection of steam into the curing section, to provide moisture, was found less satisfactory and effective than hand spraying of the walls, which was thereafter specified. Upon setting, some circumferential lining cracking was observed; these however, had completely healed when a later inspection was made after the main had been in use 8 months. Hammer-tapping revealed the lining not to be loose at any of such locations. The Pitometer Company's check tests, made on a 9,000 foot stretch, showed "C" values of 140 to 142 for this 48 inch line after 18 months of service.

Folowing experiences with the 48 inch main, 2 miles of new 60 inch Dresser coupled steel main with 7 feet of cover was also ¼ inch cement lined by the "Centriline" Corporation of New York City, employing the same method but with improvements and greater speed resulting from experiences gained on the 48 inch job.

On the 48 inch job the average daily run was 350 feet and maximum 1350 feet in 8 hours. The contract price was $2.79 per foot. The work

Programmers

Louis A. Geupel, Supt. of Water, Evansville, Ind.

J. Clark Keith, Mgr. of Utilities, Windsor, Ont.

was completed in 44 work days. On the 60 inch job the cost was only $2.50 per foot, the average daily run being 705 feet and maximum 1680 feet.

Mr. Schoonmaker pointed out that because of the cement lining wall thickness of the 60 inch main was reduced 1/16th inch, feeling that this economy was justified because of the protection supplied by the lining. A project now under construction involves 7,000 feet of 42 inch steel main also being cement lined after laying and testing.

"Experiences at Akron, Ohio"—by Wendell R. LaDue, Chief Engr. and Sup't., Water Dep't., Akron, Ohio.

Mr. LaDue described the cleaning and lining of old "Lock-Bar" steel supply mains in place, involving 20,000 feet of 36 inch and 14,000 feet of 40 inch mains in place. Without this effective means of rejuvenation replacement of these conduits would have soon been required because of the increasing number of leaks, necessitating continuous repairs.

Cleaning of the Akron supply mains was done by the National Water Main Cleaning Co. of New York City, and the lining by the "Centriline" Corporation at a contract cost of $2.50 per linear foot. Mr. LaDue described methods employed in selecting the correct mortar composition, etc. (For details see his paper in the October 1940 (p. 469) issue of this magazine.) The job was successfully done even in the face of the fact that the horizontal lock-bar protruded from the pipe side walls the entire length of the mains.

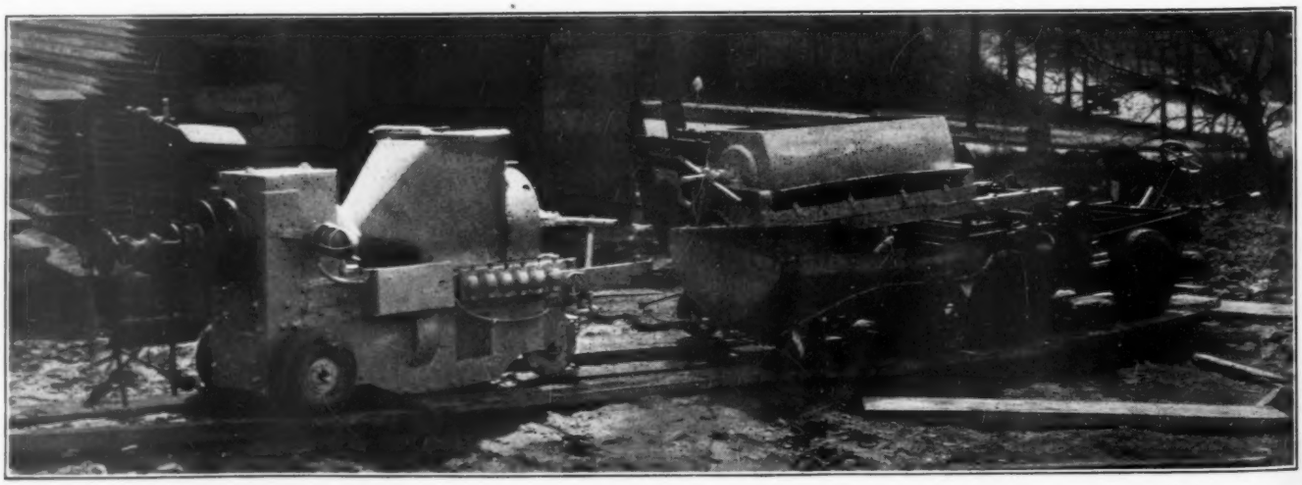
"Experiences at Cincinnati, Ohio"—by Carl A. Eberling, Sup't. of Water, Cincinnati, Ohio.

Mr. Eberling's paper told of the successful cleaning and lining of a 34 year old 48 inch cast-iron main approximately one mile long, resulting in raising its "C" value from 93 to 143, as determined by Pitometer Company tests before and after lining.

This main was cleaned by the National Water Main Cleaning Co., and a ¼ inch cement lining placed by the Centriline Corporation in the same manner as the linings applied in Akron and Toledo. To clean and line this main, six sections were cut out with special air tools designed by the Water Department and replaced thereafter with mechanical couplings. Only 9 working days were required to complete the entire job. Before running through the centripetal lining machine all bell and spigot joint spaces were filled flush with mortar by hand. Cost figures were not cited by Mr. Eberling.

A.W.W.A.'s Electric Grounding Research Program

At this point *Professor Rolf Eliassen* of New York University (Department of Sanitary Engineering) presented a preview of the research program, financed by A.W.W.A. and



Centrifugal Machine and Mortar Buggy of Type Used in Cement-Lining Akron, Toledo and Cincinnati Mains

(Picture from article by W. R. LaDue, W. W. & S. Oct., 1940, describing the Akron lining project.)

Jas. C. Harding, Consulting Engr., Mt. Kisco, N. Y., and Wm. G. Banks, Distribution Engr., Newark, N. J.

Walter E. Walker, Chief Engr., Poughkeepsie, N. Y., and Thos. A. Cole, Supt. of Filtration, Poughkeepsie, N. Y.

Samuel B. Morris, Dean of Engineering, Stanford Univ., Calif., and Jim. R. Barker, Mgr., Neptune Meter Co., San Francisco

David L. Erickson, City Engr. and Supt., Lincoln, Neb., and H. V. Pedersen, Mgr., Water Dept., Marshalltown, Ia.

J. A. English, City Engr. and Supt., Salisbury, N. C., and Geo. S. Moore, Supt., Water, Light and Sewerage Albermarle, N. C.

being conducted at New York University, for the purpose of gathering more exact information pertaining to the true effects of electrical grounding on water pipes in respect to corrosion, and tastes and odors.

The effects of both D.C. and A.C. currents on copper, red brass, lead, and galvanized iron pipes in parallel are to be investigated. The effects on the chemical quality of the water and the solubility of the pipe metal is to be studied by the new and rapid polaragraphic method, involving a dropping mercury electrode and photographic recordings of the readings. Professor Eliassen explained the method as one which eliminates the human equation in sampling and in conducting otherwise tedious and exact analytical work required for determining such microscopic quantities of metals as are to be expected in this study. This study is being sponsored and financed by A.W.W.A. to throw more light on the controversial question of how important is electrical grounding in respect to deleterious effects on water quality and water piping. It is to supplement the work of the Joint Committee on Electrical Grounding which has not been able to reach undisputed conclusions regarding the harmfulness of present-day grounding practice.

Papers Before the Plant Management Division

(L. S. VANCE, Presiding)

The following topics presented in the opening session on Plant Management were covered in the first installment of this report in our July issue.

"Factors in the Control of Reservoir Silting"—by C. B. Brown.

"Equipment Available for Emergency Repairs to Distribution Systems"—A symposium participated in by Clinton Inglee, H. Y. Carson, Rossiter Scott and Nelson Thompson.

"Water Main Extension Policies in the U.S.A."—by L. A. Jackson, Manager, Water Department, Little Rock, Ark.

Mr. Jackson's report on the water main extension problem was based on a survey conducted by him to assemble practices and policies of the 52 American cities of 100,000 to 200,000 population. Replies received from 28 cities revealed that for financing extensions to outlying districts 17 employ a "Revenue Guarantee" plan and 5 use the "Assessment" method. Thirteen cities derive funds for extensions from water rates combined with revenue bond sales, and some form of special assessment or tax; whereas, 9 cities make water rates do the whole job, and 6 cities depend on assessments or special tax for liquidating revenue bonds sold for the purpose.

In 25 of the 28 cities the final decisions as to making extensions rests with the manager of the water department. Twelve have special plans devised for extensions beyond city limits.

In order that a main extension for consumer service may be put on a self-supporting basis, the return in the nature of gross income from the section of new main must be 25 per cent of the actual cost of the extension. This figure was arrived at by Mr. Jackson through realization that for each $1.00 invested in distribution mains, $2.00 is a representative average investment in supply facilities required to bring the water to the distribution pipes. Assuming a 5 per cent yield on the cost of the system to be reasonable, then considering the 2 to 1 cost ratio of supply facilities to distribution mains, means that the yield from the extension must, in fact, be 15 per cent rather than 5 per cent. In addition to interest on investment there are operating charges to consider. With operating ratios averaging about 40 per cent of total costs, only 60 per cent of the gross revenue can properly be credited to paying for extensions. Therefore, dividing 15 per cent by 0.6 the 25 per cent requirement, in the way of return on the *bare* extension cost, is arrived at as a sound financing base.

All cities reporting retain ownership and title to main extensoins, regardless of how financed. Sixteen cities charge for an extension of 6 inch pipe, even if a larger size is installed for future demands, while six charge for the actual size pipe to be installed. Where assessments are levied there is no uniformity regarding periods of assessment collection, such varying from 3 to 15 years. None of the 28 cities allow special water rates during the financing period nor is interest allowed on money advanced by the applicant.

Regarding services, 10 cities require that the consumer pay for and maintain the service line from the main in; 13 from the curb box in; 5 from the property line in.

(From Mr. Jackson's survey returns it is clearly evident that uniformity in the matter of financing main extensions is conspicuously lacking, and the desirability of setting up reasonable standards of practice, as a guide in financing main extensions is quite evident.—Ed.)

"Development of Houston's Water Supply"—by G. L. Fugate, Chief Engr., Water Department, Houston, Texas.

Mr. Fugate told of the water situation of Houston, Texas, where the supply is taken from deep wells of the gravel pack-type. These have been becoming increasingly costly to pump because of recession of the water table, caused by heavy draft on privately owned wells in the area. It was noted that only 40 per cent of the total supply for Houston is derived from city-owned wells.

Pointing out the dangers of pumping the city-owned wells any harder, and the added pumping costs of $10 per m.g. for each further foot of draw-down, Mr. Fugate briefly reviewed the several engineering reports made on the situation and the proposals for additional supply. He then reported on a staff investigation, leading to the choice of a 15 mile distant impounded surface supply (San Jacinto River with safe yield of 100 m.g.d.) to augment a 75 m.g.d. safe yield from the existing wells. For the immediate future

only 50 m.g.d. need be developed on the San Jacinto. Placing of all privately owned wells (industrial supplies in particular) under city control, as to draft limitations, appeared to be an essential requirement if the city's wells were to be safeguarded against eventual salt water intrusion and increasing pumping costs. There appeared no particular problem in developing the dual supply, and the quality of water in the ground and the surface supplies made blending of the two waters practical.

L. R. Howson, in discussion, pointed out that the Houston water system, like the city, had suffered growing pains due to the 30 per cent population increase in the last decade. Investment in water supply facilities on a per capita basis ($25.00) was just about half that of other cities of 400,000 population. In the existing wells the drop of water level, now at an average rate of 4 ft. per year, represented a total drop of 200 ft. Having made a study of the Houston situation only a few years ago, Mr. Howson considered the Fugate plan, combining expediency with sound economics and engineering, to be a happy solution.

In reply to a question, Mr. Fugate stated that Texas had laws controlling oil wells but so far none controlling water supply wells.

"Protecting Buffalo's Pumping Station Against Service Interruptions" by Leonard A. Bergman, Director of Water, Buffalo, N. Y.

Mr. Bergman, using lantern slides, described the Buffalo Pumping Station catastrophe when a chunk flew from the casing of a check valve on a 60-inch discharge line, to completely flood the main pumping station within a few minutes, and put it out of commission for several days. He described the steel bulkheading, installed since, to separate pumping units for a height of 9 ft. An overflow into the Niagara River will preclude water topping any of the bulkheads between the separate motor pump compartments and the steam station.

Dewatering pumps of large capacity has been provided for prompt pumping out of any flooded section. A complete new central control station has been provided for operating all hydraulic valves in the station, there being three pressure-water sources for the purpose. What happened at Buffalo was the inability to close large hydraulic valves because of failure of the single pressure water supply when the break occurred. The new control system will close a 60″ gate in less than 5 minutes.

Mr. Bergman then showed slides of Buffalo's two new mobile gate operating outfits, consisting of an air compressor and Dean Valve Operating Unit, capable of closing 36″ gates under unbalanced pressure of 80 lbs. in about 15 per cent of the time required for manual closing.

Geo. M. Sacks, Director of Water, Allentown, Pa., and M. G. Mansfield, Consulting Engr., Pittsburgh, Pa.

Hersey Meter's O. P. Hanks and "Bill" Cambridge and Supts. O. P. Smalley, Highland Pk., N. J., and C. F. End, Raritan, N. J.

I. "Mike" Glace, Consulting Engr., Harrisburg, Pa., and R. E. Wagner, Engr., Zeolite Chemical Co., Medford, N. J.

J. A. Hickey, Utilities Director, Cleveland, O., and W. L. Havens, Pres., Havens & Emerson, Engrs., Cleveland, O.

W. W. Brush, while Chief Engr. of the New York system, said they had experienced difficulties with mechanical valve closing units, finding manual closure necessary toward the end of the closing operation against unbalanced pressures.

John C. Detweiler, Chief Engr., Metropolitan Utilities District, Omaha, Neb., said that, based on experience in emergency closing of three 36″ valves against unbalanced pressure, he could vouch for the dependability of the Dean Valve Closing Unit in this important service.

"The Control of Automotive Equipment" by Louis A. Geupel, Sup't of Water, Evansville, Indiana.

Mr. Geupel's paper represented a review of data obtained from 33 cities in the 100,000-200,000 population class, regarding the maintenance and operation of automotive equipment by Water Departments. Involved were 660 cars and trucks, representing 5.5 million miles of operation in 1940. The following is a tabulated summary of the information gathered from the 26 U. S. cities.

	Max.	Min.	Avg.
Miles per gal.	13.1	6.7	10.3
Cost per mile[1]	6.3	1.6	2.9
Cost per mile[2]	6.8	1.6	3.1
Cost of oil[3]	17.2%	4.3%	8.3%
Repairs, tires, batteries[4]	74.0%	34.0%	52.0%
Insurance and depreciation[5]	31.0%	12.0%	22.0%

[1]With gasoline figured at 10 cents per gal.

[2]Actual cost—gasoline at various prices.

[3]Oil cost, expressed in per cent of gasoline cost.

[4]Expressed in per cent of net cost, exclusive of insurance and depreciation.

[5]For four fleets only—expressed in per cent of net cost.

The following pertains to gasoline mileage for cars and various sizes of trucks.

	Gasoline—Gals./Mile		
Type of Unit	Max.	Min.	Avg.
Cars (136 units)	15.8	7.3	12.8
½ ton pick-up trucks (183)	13.5	9.8	11.5
¾ and 1 ton trucks (13)	12.0	9.3	10.5
1½ to 3 ton trucks (118)	9.9	5.9	7.3
4 and 5 ton trucks (14)	6.9	3.1	6.5

Mr. Guepel recommended the keeping of uniform records for automatic equipment by weight, segregating equipment by weight, in order to secure an effective breakdown and comparison of costs. Since many economies might be found through a study of automotive equipment maintenance and operation, it seemed important for managers to make such studies. For instance, if gasoline consumed by all units in the survey be reduced on the average by obtaining only 1/10th of a mile more per gallon the saving made would be 55,000 gallons of gasoline in one year.

Mr. Geupel recommended that a committee be established to study automotive equipment operation and maintenance and develop uniform record forms. The Division, thereupon, voted that such a committee be set up in A.W.W.A.

Metering and Rates

"Meter Reading and Operation of Commercial Departments" by Kenneth K. King, Director of Water, Kansas City, Mo.

Mr. King's paper reported data procured in a survey of U. S. cities in the population range of 80,000 to 220,000, to determine costs of meter reading and expense of operating commercial departments. The data secured from 47 cities is assembled in two tables—one for Northern cities and one for Southern cities. The tables list each city by name and give detailed data for each, which includes the following:

25 *Northern Cities*	Max.	Min.	Avg.
Meters read per year per meter reader	48,400	6,079	24,750
Annual salary of readers	$2,100	$1,200	$1,600
Reader cost, per meter read	32.5c	3.2c	7.6c

Chas. Richardson, Chief Engr., Bldrs.-Providence, R. I. | *Pat. Kelly, N. Eng'd Mgr., The Leadite Co., Philadelphia* | *R. H. Ellis, Engr., Factory Mutual Fire Ins. Co., Boston* | *H. F. Wagner, Chief Chemist, Water Dept., Buffalo, N. Y.* | *F. C. Jordan, Secretary, Ind. Water Co., Indianapolis* | *Webber Knight, Manager, Natrona Water Co., Natrona, Pa.* | *E. A. Sigworth, Industrial, Chemical Sales Co., New York* | *E. M. Johnson, Supt., Water Dept., Raleigh, N. C.*

13 *Southern Cities*

	Max.	Min.	Avg.
Meters read per year per meter reader	117,786	22,500	68,440
Annual salary of readers	$1,800	$1,200	$1,530
Reader cost, per meter read	5.3c	1.5c	2.5c

Mr. King commented that salaries paid meter readers apparently have no relation to locality, except that they seem to be slightly higher in the Northeast and California. The average salary for all cities is $130 per month, with a minimum of $100 and maximum of $185 per month. The great variation between 6,000 meters read per year-per reader and almost 118,000, indicates that many readers either have time on their hands or do other duties.

Interesting disclosures are, that in the 47 cities meters are still 30.5 per cent customer owned (average for all cities), and 88 per cent of the departments bear the cost of repairs to meters.

From the commercial department tabulations the following data is of particular interest.

For 18 *Northern Cities*

	Max.	Min.	Avg.
Annual cost per active service	$2.00	$0.75	$1.55
Cost per bill	73.8c	18.4c	40.5c
Accounts delinquent	25%	1%	7%

Of the above 18 Northern cities, 86 per cent mail bills and 14 per cent use hand delivery; 55 per cent use the ledger system and 45 per cent the stub system; 39 per cent practice delinquency penalty and 61 per cent do not; 35 per cent also practice rigid shut-off rule and 65 per cent do not; only 33 per cent allow discounts for prompt payment and 67 per cent do not.

For 10 *Southern Cities*

	Max.	Min.	Avg.
Annual cost per active service	$2.33	$1.06	$1.62
Cost per bill	30.5c	9.5c	16.8c
Accounts delinquent	20%	2.3%	7%

Of the above 10 Southern cities, 65 per cent mail bills and 35 per cent deliver by hand; only 40 per cent use the ledger system and 60 per cent use the stub system; 80 per cent practice penalty charge for delinquency and only 20 per cent do not; rigid shut-off rule is followed in 80 per cent of these cities, and only 20 per cent allow a discount for prompt payment.

Mr. King commented that the average commercial department expense per active service for all 37 cities was $1.57 (North $1.55; South $1.62); the average expense per bill being 22.7 cents (North 40.5 cents; South 16.8 cents)—the higher unit cost in the North being because only one-third as many bills are sent per year (quarterly billing) as in the South.

Concerning the delinquency record, no apparent relationship exists between percentage delinquent and whether the penalty or the discount plan is in force. While the use of the ledger and the stub systems is about equally divided, the data fails to indicate that either shows a governing effect on costs per bills or per active service. However, taking the two methods alone the stub system might seem to show a lower cost.

"Meter Maintenance Practice" by Arthur P. Kuranz, Sup't of Water, Waukesha, Wis.

Mr. Kuranz reported the results of his survey of 16 Canadian and 36 U. S. cities, in a population range of 30,000 to 200,000, for the purpose of securing a cross-sectional picture of prevailing Meter Maintenance practices. (In as much as Mr. Kuranz' interesting and enlightening report has been printed in full in our August issue, a digest of it here would seem to be unnecessary.—Ed.)

Based on the survey statistics and Mr. Kuranz' own valuable experience and knowledge of meter testing advantages, the following recommendations by the author are pertinent:

1. Test all meters when purchased.
2. Remove them after a certain time period or time and consumption combined.
3. Test them when brought into the shop for repair. Keep a record of these tests.
4. Repair carefully, especially chamber and gear train. Keep a record of repair costs, including labor.
5. Test after the repairs. Require a high percentage of registration on ¼ g.p.m. flow.

If you will do that, you will notice a distinct increase in your revenues. *Ask those who have followed this plan.*

"Status of New Meter Specifications" by Sam F. Newkirk, Sup't. of Water, Elizabeth, N. J.

Mr. Newkirk, reporting as Chairman of the Committee on Meter Specifications, stated that the proposed new specifications covering displacement meters had been completed and approved by members of the committee. They now are ready for consideration by the Water Works Practice Committee and the Board of Directors, prior to publication. This committee is a Joint Committee of A.W.W.A. and N.E.W.W.A.

Mr. Newkirk noted the more important changes made to the existing specifications to be displaced, as the following:

(1) Accuracy on the ¼ g.p.m. flow to be raised from 90% to 95% minimum. (All other specified test flows to show accuracies between 98½ and 101½%, instead of existing specifications calling for 98 to 102%.)

(2) The present permissible loss of head of 25 lbs./sq. in. for all size meters has been changed—to-wit:
For meters smaller than 1 in.—15 lbs.
For meters larger than 1 in.—20 lbs.

(3) Threads for connections (now both tapered and straight threads) are to be standardized. The standard thread adopted will be interchangeable with all present threads now in service. It was developed by employing a consultant to develop such a combination thread.

In addition to the above, all sections of the present specifications have been materially clarified or amplified, and numerous changes of less importance made. The next job of the committee is to develop specifications for current type, compound and fire service meters. Mr. Newkirk stated that the committee would welcome suggestions of desirable

R. K. Blanchard, Mgr. of Sales, Neptune Meter Co., New York | *H. F. Blomquist, Supt., Water Dept., Cedar Rapids, Ia.* | *"Bill" Irwin, Louisville Lime Co., Cincinnati, O.* | *Frank Brooks, President, Art-Concrete Wks., Pasadena, Calif.* | *Geo. L. Wirtz, Atlas-Mineral Prod. Co., Mertztown, Pa.* | *E. H. Lewis, President, Tate Pipe Linings, Andover, Mass.* | *Earl Norman, Supt., Dept. Utilities, Kalamazoo, Mich.* | *Fred Stuart, President, Stuart-Brumley Co., Baltimore, Md.*

changes for the larger meter specifications from any user.

"Special Rates and Free Water Service" by Dale L. Maffitt, General Manager, Des Moines (Ia.) Water Works.

Mr. Maffitt's report constituted a collection of facts concerning reduced water rates for special uses and large industrial consumers, free water for municipal and public uses, and opinions expressed by water utility managers relative to both. It was the author's opinion that evidence at hand indicated special summer rates, to encourage increased water use for lawn sprinkling and in air conditioning, had proved of doubtful merit.

The following are case histories and opinions received from various cities:

Tulsa, Okla.—Has a sprinkling rate of 10 cents per 1,000 gals. as against 35 cents for the first 1,000 gals. Believes special rate should be abandoned.

Duluth, Minn.—Boast no free water for any use; also gets paid for fire protection.

Miami, Fla.—Has no special rates. Water Company is paid $30 per year hydrant rent but nothing for water used in street and sewer flushing.

Fort Dodge, Ia.—State law requires uniform rates to all. No income, however, from any form of fire protection service—not even for private sprinkler systems.

Greenville, S. C.—Water Department collects nothing from city for any uses.

Denver, Colo.—Supplies no free water for whatever purpose and collects $22.50 as annual rental per fire hydrant. Water Department pays no taxes.

Los Angeles, Calif.—Allows a 50 per cent discount to charitable institutions.

New Orleans, La.—Water Department contends water-selling to be only an incidental function in this city where improved sanitation and fire protection was the basis on which the private water works was purchased by the city. In consequence, unaccounted for water, for the most part used in sewer and street flushing, amounts to 27 per cent. Only 55 per cent of the water pumped is actually billed for. (If the report stated where the other 8 per cent went we failed to note it. —Ed.)

Mr. Maffitt reached the conclusion that "free-water" was still a problem, and as ever discouraging to managers desirous of running the water utility on a sound business-like basis. Furthermore, free-water is an impediment to water works financing through sale of revenue bonds.

Ross L. Dobbin, General Manager, Petersborough (Ont.) Utilities Commission, in discussion stated that in Canada the Commissioners set the policies, and the manager's duty is to see that such are carried out. As for free water, no such thing existed in Ontario, where the commission form of management is almost universal.

Papers Before the Finance and Accounting Division

(JOHN C. FLANAGAN, Presiding)

In the opening session of the Finance and Accounting Division the first paper presented dealt with **"Water Rate Structures in Canada"** —In a joint paper A. E. Berry, Chief Engr., Ontario Dept. of Health, delivered Part I which constituted a discussion pertaining to **"Domestic Rates"** and William Storrie, Consulting Engineer of Toronto, discussed **"Charges for Municipal Services and Fire Protection."**

Dr. Berry, in his opening remarks, directed attention to the very useful "Information Exchange" maintained since 1935 through the Canadian Section of A.W.W.A., for which water works statistics and operating and financing data are collected, tabulated and distributed to members. That section devoted to "Finance, Accounting and Rates" keeps members informed of prevailing methods and rate structures of all progressive Canadian water works. Such up-to-date date constituted the source of information which permitted ready preparation of Dr. Barry's and Mr. Storrie's paper.

Canada has approximately 1,300 water works systems almost exclusively publicly owned. Canada's water works are for the most part administered by a Utilities Committee or a Special Committee of the municipal council. Rates, like in the States, are more often than not based on what is done elsewhere, rather than on the actual cost of the service. Statistics reveal that only 37 per cent of the residences are metered, whereas 94 per cent of the industrial and commercial services are metered. Thirty-six per cent of the total water distributed is metered and accounts for 37 per cent of the whole of the water-sales revenue.

As to rate structures, flat rates are based on fixtures, number of rooms, or number of persons in the house. Some cities have long used the tax assessed value of the property as the base for the flat service charge—notably Hamilton, Kingston and Ottawa. In Montreal annual rental value of rented properties is also employed as the base.

As to meter rates, a "meter rental charge" comprises the service charge. There is a minimum charge which may or may not also cover "Meter Rental." Sliding rates, varying with the amount of water consumed, are in general use. Billing periods vary considerably; 62 per cent using the 3-month interval; 17 per cent the 2 month interval, and only 9 per cent bill monthly. The cost of meter reading averages 25 cents per meter read. In some Canadian municipalities the taxpayer stands a good part of the capital investment—that part for portions of the system required for fire protection rather than furnishing water for consumers' use.

In a rate study picture, a typical residence of 5 rooms, 4 occupants, assessed value $2,000 and 45 foot frontage, was taken. For such a residence, the average metered charge for 25,000 gals. per year would be $14.45. If charged on the best flat rate schedule the annual bill would have been $16.00.

The average cost of maintaining and operating water systems in Canada (including bond interest and debt retirement) is $4.83 annually per capita, $2.14 being for debit charges. Charges for water supplied covers a range of 8 to 15 cents

Edw. V. Buchanan, Gen'l. Manager, Public Utilities, London, Ont. (Not afraid of politicians.)

Ross L. Dobbin Gen'l. Manager, Public Utilities, Peterboro, Ont. (No free water in Ontario.)

per 1,000 gals.—the average being 13.75 cents. The two largest Canadian cities had an annual per capita cost of $4.02 and $4.90 and a cost of 11.7 cents per 1,000 gals. for water supplied the consumer. Capital costs for Canadian filtration plants is roughly $11.35 per capita. On design capacity, filter plant cost averages $67,965 per million capacity.

In Ontario the owner of rented dwellings must provide the tenant with a satisfactory supply of water and pay the charges for water service. In consequence one meter and one billing serves multiple dwellings and apartment houses.

"Canadian Charges for Municipal Services and Fire Protection" by William Storrie, Consulting Engineer, Toronto.

Taking his statistics from 108 cities supplying information for the Canadian Section's "Water Works Information Exchange," Mr. Storrie reported the following as representative rates for municipal services and fire protection. On the main basis the average is 0.723 cents per inch-foot per year; rental per hydrant, $40.42; cost per capita, 46.6 cents. On private property hydrant rental is $50 maximum and $2.00 minimum; sprinkler service charges $15 to $75 per year, or 3 to 10 cents per sprinkler head. However, charges for this service is not universally made.

Of the 108 Canadian water systems in question 70 are managed by Public Utility Commissions; 38 by councils; only 1 by private company. In Canada no fire rating schedules are established, equivalent to those of the National Board of Fire Underwriters in the U. S. Canadian Fire Underwriters do make interim reports in cities but these are difficult to interpret. A closer relationship between this agency and water works authorities is much needed, as is a more exact determination of what fire protection costs are, and in developing rate schedules on a more business-like basis. This last was Mr. Storrie's closing plea.

"Denver's Financing and Accounting Methods" by George F. Hughes, Manager, Board of Water Commissioners, Denver, Colo.

Mr. Hughes stated that the water works of Denver dated back to 1870; filtration, 1884; city ownership since 1918. Managed by a Water Commission, the board members serve 6 year terms staggered to provide overlapping membership.

Rates are set on a non-profit basis. Operating expense averages 50 per cent of gross income, the latter averaging $3,000,000 annually. Surplus water works income is transferred to the City Treasury, but can *not* be used for any other than water system betterments.

Denver's 1,700 services are only 3 per cent metered. Only one-half of one per cent of the accounts are in arrears after each quarterly collection. The matter of sparse metering is explained by the fact that Westerners can not afford to risk a loss of their all-important "Water Rights," which in Denver's case calls for a return to the waterway of all but 8 per cent of the water taken from the source. The latter is watched carefully by metering sewage flow.

Denver now has $42,000,000 invested in its water supply system, which is the result of $26,600,000 in bonded debt and $15,360,000 cash put in from earnings since 1918. A traveling auditor keeps tabs on accounting over the entire system; an Annual Report is published in detail and each division of the department must be run on a self-supporting basis.

At the F. & A. Division luncheon a motion picture in color of the scenic Denver system was shown.

"Management Problems in a Municipal Utility District" by John S. Longwell, General Manager, East Bay Utilities District, Oakland, Calif.

The East Bay Municipal Utilities District (established 1923) includes a number of cities, the more important being Oakland and Berkeley, and six County Water Districts, embracing a 200 sq. mile area with a population of 540,000. In addition to water-supply as the primary consideration, the district may handle sewage and garbage disposal, and perform other services in the interest of the general public. To date water supply only has been handled.

A. E. Berry, Chief Engineer, Ont. Dept. Health, Toronto.

L. G. Lenhardt, Gen'l. Manager, Water & Sewage Dept. Detroit.

The management is a 5 member Board of Directors, each elected at large to serve a 4 year term. The recently retiring president has served on the Board for 18 years, indicating the few changes taking place in the Board membership, which is considered a public service of high confidence. Certainly the fee of $10.00 per meeting attended lends no attraction and $20.00 monthly is the limit, although 4 or 5 meetings are held each month.

Except for the General Manager and three other officials, all 850 employees of the District are under civil service, as far as is permissible.

In 1924 a bond issue of $39,000,000 was voted to bring into the District water from the Mokelume River, 100 miles distant but good for a 200 m.g.d. yield. The Pardee Dam, impounding 68,000 m.g., a 93-mile steel aqueduct with two pumping stations thereon, and 15 miles of pipe lines to distribute water to terminal reservoirs of the District, was completed in 1929. A year previous the District with $26,000,000 had purchased the facilities of the private water company in the District and consolidated the two systems, representing an investment of $65,000,000.

Since the water has to be distributed at elevations ranging from sea level to 1,500 ft. (water from the aqueduct being delivered at 300 ft.

above sea level), the problem of distribution is intricate. It involves operation of 44 pumping plants, 23 distribution reservoirs and 45 storage tanks. Of the 76 pressure zones 48 are served from reservoirs and tanks direct, while 28 are served through batteries of pressure regulators.

The water rate involves a monthly standby charge, based on meter size, and a sliding scale quantity rate applied to all classes of consumers alike. The District is 100 per cent metered and there are no "special rates" of any nature.

During the year water sales revenue from 151,000 services billed monthly ran to $5,260,000. Revenue from power sales to the power company ran to $381,000 and other revenue added grossed $6,196,000. In addition $945,000 was collected as the yearly diminishing assessment levy for bond retirement.

Each city pays the District a fire protection charge computed on a modified inch-foot basis, and taking into consideration all parts of the system required for more than actual consumer needs. In May, 1940, rates to large users were again reduced, resulting in switches to the District system from private wells. Several rate reductions made since taking over the private system have resulted in $800,000 annual savings to present consumers.

Public Relations receives a large measure of attention. Bills can be paid at four conveniently spotted District offices, 49 branch banks and 9 agencies within the District. A business agent calls on every new customer to check up on services and explain the system, policies and aims of the District management. If a complaint is received a trained service inspector is sent to call on, *and satisfy*, the customer before closing the case. Special efforts are made to give information about the District to clubs, schools and other organizations. In this direction an interest-creating and educational sound movie was made in color and has to date been shown on 267 occasions. *"At the Turn of Your Faucet"* has proved worth several times its cost to the District, and informs the general public as no other method can, although frequent distribution of informative leaflets in the envelope carrying the bill is practiced also. The District participates in garden-club and other community activities —has ample water, and makes efforts to encourage its greater use, and enjoyment of its use, as yielding the most for the dollar of any commodity purchased by the public.

Wm. Storrie, Consulting Eng'r. Toronto.

Geo. F. Hughes, Gen'l. Manager, Denver.

A retirement plan for employees has been in operation since 1937. Payroll deductions made monthly are matched by District contributions. Retirement is compulsory at age of 70. There is an employees' association which, with the District's aid, publishes a monthly magazine. Under preparation is an Employees' Manual, designed for improved employee service and advancing good public relations, as well as employee relations with the District.

(This is a rather lengthy digest of Mr. Longwell's paper, but one could see that the successes of the East Bay Utilities District operations can readily be traced back to the spirit and "everyday" actions of the men at the top. We believe that the "human relations" phases of the District's program is deserving of all the space here given to an enthusiastic presentation at Toronto. —Ed.)

"Experiences with Federal Housing Developments" by Hal F. Smith, Senior Administrative Asst., Dep't of Water and Sewerage, Detroit, Mich.

In the author's absence this paper was read by L. G. Lenhardt, Gen'l Mgr., Dept. of Water Supply and Sewerage, Detroit.

Mr. Smith reported on experiences with the U. S. Housing Authority, which requested, and expected, special reduced rates for water supplied U.S.H.A. housing developments, the reason given for asking such reduced rates being purely a charitable one. The water in question was intended for low rental apartments in slum clearance projects.

Investigation by Mr. Smith revealed that the gas companies belonging to the A.G.A. were accepting wholesale rates through a master-meter to such developments. Electric companies in the Edison Institute have in numerous instances offered a special "Social Rate" to the U.S.H.A.

Detroit's legal advisors gave the opinion that "special rates" could be shown to be legal, if logical and supportable. Mr. Lenhardt closed by saying that it was the intent to allow a wholesale water rate through master-meters, and this would limit the favoritism shown.

Carl Chatters, Secy., Municipal Finance Officers' Ass'n, warned against the precedent of making "Social Rates" and the sooner any privileged rates were wiped out the better for all concerned.

"Joint Administration and Collection of Water and Sewer Accounts" —a committee report by Chairman Leonard N. Thompson, Chief Engr. and Sup't of Water and Sewerage, St. Paul, Minn.

Mr. Thompson's report began by saying that the distinctive advantages of joint administration and collection of sewerage service charges, becoming more popular daily as a sound method of financing sewage disposal, far outweighed the few disadvantages or difficulties involved. At this time 27 states have satisfactory legislation legalizing issuance of Revenue Bonds for sewerage financing and supported by sewer rental collections, either separately or as a charge added to the water bill.

In this connection the principal problem is that of developing the proper sewer service charge, which above all else should be adequate at the beginning, since scaling such charges down would be far simpler than an attempt at an upward revision. Of the methods of developing the required operating and maintenance income, the "Combination Method" appealed as the soundest legally, and also the most equitable. This method involves the combination of property assessment (sewer tax) to cover the structural works (sewers and treatment works) because all properties, and the community, benefit from the availability of safe and adequate sewage collection and treatment. This base income is supplemented by the "Sewer Service Charge" which is an expense borne only by those actually using the sewers, and is a graduated charge based on the extent of sewer use. The two charges may be likened to those of water departments which finance fire protection costs from the property tax and operation through service charges plus a water use rate.

In developing sewer service charges the Water Sup't should participate, since he will be charged with collections if not the actual management of the sewerage system.

The methods previously used have involved many combinations in arriving at the monthly or annual service charge. However, the committee is of the opinion that the metered-water base is the only sound one in charging for sewerage service. With this method adjustments may be justifiable in special cases, and in such cases it is not overly difficult to establish the equitable charge. Above all, the rate structure should be held to the simplest possible combinations of charges, or basis of cumputing the charge.

Concerning billing and collection difficulties, such have been more imaginary than real. The Committee feels that separate bills are expensive and not justified. The sewer charge should be shown as a separate item and added to the water charge, *and become payable with the water charge,* thus materially simplifying collections as well as billing. While the water utility may be only the collecting agency, it is still its duty to make as certain an effort at collecting sewer charges as it does in collecting water charges.

John A. Hickey, Director of Public Utilities, Cleveland, Ohio, in a scheduled discussion, reviewed sewerage financing history in Cleveland, wherein payment for operating charges for sewage treatment for several years from water sales income had been declared illegal. Proposed substitution of a sewer rental charge had been bitterly fought by council members and by contiguous communities served by Cleveland's water and sewers. Eventually having no legal funds for sewage treatment necessitated closing of plants. This brought prompt enactment of the "Sewer Rental Ordinance," but at a rate considered scarcely adequate. Subject to later revision, the present rate of 18 cts. per 1,000 cu. ft. of metered water used represents a compromise from the proposed rate at a flat 25 per cent of the water bill. Small consumers are billed quarterly, as in the case of water billing, and large consumers monthly. The problem is the adjustment of large consumers' bills to comply with the intent—namely, the extent of sewered water and not that which may go into products, steam, etc. Delinquent accounts were seen at about 16 per cent—only 25 per cent of which have mounted to more than $10.00.

L. G. Lenhardt, Gen'l Mgr., Dept. of Water Supply and Sewerage, Detroit, also a scheduled discussion, reported on Detroit's sewer rental collection experience. Stating that

H. A. Van Norman, Gen'l Mgr. and Chief Engr., Dep't Water and Power, Los Angeles.

L. N. Thompson, Gen'l Supt. and Engr., Water Dept., St. Paul, Minn.

what had been feared as a highly troublesome problem had in truth not proved so. The method had worked out very satisfactorily with surprisingly few objections or complaints from water users. This fact could only be explained by Detroit's good fortune in the important factor of choosing basically sound rates.

Detroit charges are a flat 11 cts. for 1,000 cu. ft. of water metered and added to the water bill. Outside of corporate limits the charge about doubles, becoming 21.6 cts. per 1,000 cu. ft. (Interesting is the 0.6 cents fraction in the suburban rate. Strangely, nobody wanted to know why.—Ed.)

In any event, reported Mr. Lenhardt, contracts have been signed by all but one, this being the only "scrap" that has developed.

The expected objection, "Why charge me for water used in sprinkling my lawns and gardens?" was promptly met with the suggestion that if Mr. Customer cared to put a meter on his watering lines an adjustment would be made. In addition he was shown what a small fraction this sprinkling water really amounted to in a complete year's billing. By further figuring, Mr. Customer quickly realizes that only a period of 50 years savings in sprinkling water deductions for the average user would pay the cost of installing and maintaining separate meters.

Concerning industrial users, Detroit's legal department has ruled that customers supplying proof of extent of non-sewered water metered to them must be credited with such amounts in making subsequent collections.

Mr. Lenhardt, in closing his remarks, stressed the importance and value of effective publicity designed to thoroughly inform the public in advance of instituting sewer service charges or such rental, which modern sanitation and sewerage treatment entails. In Detroit this procedure had done much to smooth their path.

Session on Security and Civil Service

N. J. Howard and John C. Flanagan Presiding

"Security and Retirement Planning for Municipal Utility Personnel"—by Dale L. Maffitt, Gen'l Manager, Des Moines (Ia.) Water Works.

Mr. Maffitt, who is chairman of Security Legislation, once again reported on progress and developments in social security and retirement plans for municipal water works employees, which group has not yet come under the Federal Social Security Act, that became effective Jan. 1, 1937, and was amended in August, 1939. However, this Act is being extended as time goes on and without doubt municipal, county and state employees will eventually be taken care of in the Federal Social Security program, unless adequately served in a State or Municipal plan. Facts in the case are that employees of those political subdivisions, including water works men, where a security and retirement plan is already in operation are objecting to the possibility that the Federal Act will not prove as beneficial as the local arrangements and the problem is how to take care of the equity that these fortunate public employees have at stake.

Looking to the interest of this group, conferences between the Municipal Finance Officers Association and the Social Security Board in Washington have developed objectives in the interest of that group of one and a half million municipal employees who now have no old age or disability protection and the much smaller group that have. In this direction three plans are being discussed and considered. The Wagner Bill now before Congress provides compulsory coverage of all state and municipal employees, regardless of existing retirement systems. The Wagner Bill, as amended, requires coverage for such employees as are not now beneficiaries of existing systems. The third consideration is that of making it a voluntary matter as to whether the municipality chooses the Federal Act or some State system, which is the equivalent or better.

Early in 1941 the committee met and recommended to the Social Security Board that the voluntary scheme appeared the most appropriate, since it permits a municipality to retain what it has already established, or to accept the Federal Security scheme if no state plan is

offered, or if that available appears less beneficial.

Mr. Maffitt's report discusses at some length the advantages and disadvantages of local systems and outlined what is required in the present Federal Security Act under the section pertaining to "Old Age and Survivors Insurance" provisions.

Only last year did Iowa legislate it legal for managements of municipally owned water works of sufficient size to secure and maintain disability and old age group insurance for employees. The present developments which seem certain to extend the Federal Act, or its equivalent, to water works employees justifies a "marking time" by those managers who have been endeavoring to establish some needed form of a retirement plan and disability protection for their employees.

(We understand that Mr. Maffitt has recently put into effect the group insurance plan at Des Moines, while awaiting developments pertaining to the Federal Act.—Ed.)

"Value of Adequate Civil Service in Water Works Operation" by John B. Probst, Chief Examiner, Civil Service Bureau, St. Paul, Minn.

Mr. Probst's paper, presented by Leonard N. Thompson, St. Paul's Water Sup't, began with some pains to differentiate between ordinary "civil-service" and what he stressed as "adequate civil-service." The latter is the only true merit system and he considered civil-service to be absolutely inadequate if any of the following dictates must be met by the department head:

(1) Preference to war veterans in the same classification with others with better qualifications indicated.

(2) Seniority rules inflexibly in making departmental changes, promotions or selections for any particular duty, although more capable men lack service age.

(3) Inability to transfer or drop men when there appears a particular advantage to do either in the interest of efficiency or discipline.

A "civil-service" which is not flexible enough to protect the managements and operating heads, as well as the employee, is obliged to be conducive to low grade management and a "skirted" unionism in which ability and ambition becomes thwarted and also secondary to pay-days and job holding. This in essence is what Mr. Probst pictured in his somewhat conservative comments on

"Straws and Specs"
"Cy" Bird, Distr. Mgr., The Pitometer Co., Chicago
A. E. Jennings, Genl. Mgr., Canadian Engr. Publications, Toronto
"Art" Clark, Manager, Water and Sewage Wks. Mfgrs. Assn., New York

the type of "civil-service," as some have it, and his ideal "adequate civil service."

The properly equipped manager will welcome "adequate" civil-service in its ability to aid his discretionary powers in the choice and handling of personnel which has already been graded as physical and mental fitness, and also price-tagged so to speak. He is benefited by the civil-service barrier against political pressure for favors in employing men of little-known qualifications or personality.

Although, said Mr. Probst, civil-service does lack in several respects, its shortcomings are on the whole outweighed by its advantages and, if of the "adequate" variety, it will continue highly useful until some better plan comes into being.

"The Limitations of Civil Service" by H. J. Van Norman, Chief Eng'r. and Gen'l. Manager, Los Angeles Water Bureau.

Mr. Van Norman in his usual two-fisted and straight-from-the shoulder manner of wading into a problem or argument, as a manager who came up under another self-made hydraulic engineer—that great benefactor of otherwise desert barriered Los Angeles, William Mulholland, took "civil-service" apart.

He pointed out several limitations and shortcomings of civil-service in respect to supplying oval pegs for round holes when round ones are not on the civil-service "eligibles" shelf. What Mr. Van Norman pointed out is that the Civil-Service Department can't appreciate that a proficient engineer on road and street work can't be used in water supply work, considering that it may take some time to break the particular engineer into methods followed in water works practice. As an example Mr. Van Norman cited experiences on the 350 mile distant Mono Basin Project where much delay resulted in having to wait for a supply of needed engineers because none were immediately available on the civil-service lists. Temporary appointments only could be made. The preparation for examination and its taking, disrupted work progress. Some proficient men failed to make the needed grade which allowed them to be drawn from the list; new names appeared and it was almost a case of start all over. Then the question again of brilliance in passing examinations, the doubtful satisfaction from the "oval pegs" and likelihood of having to call for other eligibles after the usual probationary period.

Another factor of importance is the classification rule which frequently limits the manager in switching employees from one to another service, even though there be only temporary or emergency need for such. In this respect there is something of the trade union aspect to civil-service that decreases efficiency and increases costs. Again no provision is made to overcome the seniority rule, which prevents switching of less effective seniors and using younger more proficient men in certain positions where vitality and ambition count.

Open competitive examinations may be held for a position and appointments made when promotional examinations within the Department would serve the Department to better advantage, and encourage career men rather than invite in those who know how to attain high examination marks but whose qualifications go little beyond that ability. Considering all of this, Mr. Van Norman believes in entrance examinations and thereafter in relying as far as practicable on promotional examinations to bring the best qualified men to the key positions.

All in all, Mr. Van Norman's summation seemed to be that meeting the law of supply and demand in personnel for water supply operators is something beyond the flexibility or ordinary civil-service.

Edw. W. Buchanan, Gen'l. Manager. Public Utilities Commission, London, Ont., presented an excellent discussion on civil-service vs. no civil-service. In Ontario municipal utilities are largely operated under a Public Utilities Commission which employs a manager. The Canadian Government has a Civil-Service but nothing comparable to civil-service in the states exists in Canadian cities. However, political interference in commission operations does not exist either—or has not in Mr. Buchanan's 27 years as a manager.

Hard for Mr. Buchanan to understand is the fact that civil-service tends to hold down salaries of managers and key men, who in private

enterprise would receive considerably more for similar work and responsibilities. Another factor is that of rules, classifications and regulations on none of which had private enterprise ever thrived, or been able to operate successfully. Certainly seniority has never made a successful private enterprise which can have no lack of freedom of action by the management. It was his feeling in looking at the picture as a distant observer, that civil-service was a wonderful cloak for inefficiency and indifference if not dishonesty of employees in any event a stifling influence on ambition and earned advancement, which is the backbone of all successful enterprise. For his part he preferred not to be afraid of political interference than to feel that his powers of selection of personnel and recognition of meritorius services through advancement of his own selection amounted to nothing more than wishful thinking. These are not the words of Mr. Buchanan, but represent, we believe, the substance of his remarks and thoughts.

Homer A. Hunter, City Engineer of Dallas, Made Water Superintendent

H. A. Hunter

• Homer A. Hunter, until recently City Engineer of Dallas, Texas, has been made Superintendent of Water and Sewerage.

Mr. Hunter received his engineering training at Texas A. & M. College and after graduation attended the Mass. Inst. of Technology where he received a Master's degree in Civil Engineering.

From 1925 to 1938 he was associated with the firm of Hawley, Freeze and Nichols, consulting engineers of Fort Worth, Tex. Just prior to coming to Dallas as City Engineer in 1940, he served as Executive Director of the Housing Authority of Fort Worth, which agency constructed two low cost housing projects, consisting of 250 dwellings each, at a cost of about $2,500,000.

Mr. Hunter is a member of the American Water Works Association and the Am. Soc. of Civil Engineers.

His Subscription Was Up (And Likewise His Jig)

When one William Heard was notified by letter from the circulation department of a Little Rock, Arkansas, newspaper that his subscription would expire March 8th, imagine the surprise of a certain circulation manager who received Heard's reply. It read in part:

> "I wish to inform you that if you read your paper as closely as I do . . . you would know that I will be hung on March 7 . . . In view of the fact that I do not know my future address I am afraid our pleasant relations must be severed . . ."

Heard was one of four convicts sentenced to hang together for breaking prison and killing a guard.

Moral: Stay out of jail; and *don't* let your subscription lapse.

Westchester Water Works Conference Organized

"Gene" Cranch, First Chairman.

Representatives from some thirty water districts in Westchester County, New York, were called together on August 20th. At that time by-laws were adopted and permanent officers elected, in accordance with wishes expressed at an informal gathering held in July.

The group, known as the Westchester Water Works Conference, was established to bring together "men interested in the problems of water supply and distribution." The hope was expressed that the closer association within the County will be of benefit to the men and aid to the districts which they serve.

About seventy water works men have enrolled in the "Three-W Conference," including delegates from both the rural and urban sections of the county. Their districts serve a population estimated at 560,000 persons. In terms of water, the various systems combined distribute nearly 50 M.G.D. on the average.

Enrollment is open to all those, within Westchester, who are, broadly speaking, "actively engaged in water works operation." One of the interesting stipulations in the by-laws is that no membership dues shall be collected.

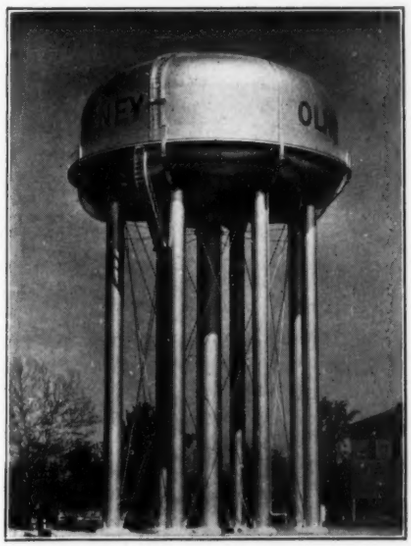
Officers for the ensuing term are: Eugene T. Cranch, New Rochelle, Chairman; R. M. McLaughlin, County Health Department, White Plains, Secretary-Treasurer; and six Directors: Frank Naylor, Peekskill; Andrew S. Grantham, Greenburgh; Frank Kelley, Valhalla; Sidney Hickock, Catonah; James F. Conlan, Scarsdale; H. T. Hotchkiss, Larchmont.

"GOOD-WILL"

One of the best definitions of "Good-will" that we have yet seen is that which follows:

• GOOD-WILL: *THE MARGIN OF SERVICE DELIVERED TO CUSTOMERS BEYOND WHAT THEY HAVE ASKED FOR.*

The Difference Between 8 and 48 Pounds



(Photo, courtesy Chicago Bridge & Iron Co.)

To our thinking, the citizens of Olney, Ill., can have nothing to complain about regarding the appearance of this water tank. The photographer as well as the tank designer both deserve credit for their jobs which made possible this pleasing picture. The colonial design lends an attractive appearance to Olney's new 400,000 gal, tank, which stands 67 ft. above ground to its radial-cone bottom.

As Olney grew stronger its water pressures grew weaker. At times there was but 8 lbs. at City Hall—not to say what that meant to residential area consumers' service on the far side of town. As a temporary expedient, booster pumping had to be resorted to as a corrective.

Now Olney's new 400,000 gallon pressure and supply reservoir has supplanted costly and none too satisfactory booster pumping. It spells the difference between 8 and 48 pounds service pressure, not to forget the asset in the nature of improved fire service and protection.

On this project Warren and Van Pragg of Decatur, Ill., served as consulting engineers.

THE LEGAL RESPONSIBILITIES OF THE WATER WORKS OPERATOR*

And a Reference to an Unjustifiable Obligation to Be Avoided

By JOHN H. MURDOCH, Jr.
ATTORNEY
AMERICAN WATER WORKS AND ELECTRIC CO.
New York, N. Y.

A WATER works operator has the legal responsibility to install, maintain and operate reasonably adequate and safe facilities and to render reasonably adequate service and to deliver to the public reasonably pure water.

That statement may cover the situation but probably a little more detail would be helpful.

A water works operator has the legal responsibility to obey specific mandatory laws and the lawful orders of the constituted health authorities. It is assumed that you know the laws applicable to your work and that as law abiding citizens you obey laws and lawful orders. A fuller statement of your legal responsibilities is needed.

While such a fuller statement is needed, some limits as to subject matter must be placed.

There have been deliberately eliminated from this paper any matters as to which the legal responsibilities assumed by a water works operator differ because the water plant is owned by a municipality, an authority or a private company. In the matters to be covered here the same principles are applicable *no matter what the type of ownership.* For that reason the phrase "water utility" is used to designate the owner of the plant whether that owner be a municipality, an authority or a private company.

A water utility acts through its individual operators, and when those operators fail in the performance of a duty or responsibility to others, then the water utility has failed. And if damage is caused, then the water utility is liable for money damages. Some types of such failures to perform legal responsibilities are to be considered.

Definitions of Some Terms

To avoid the necessity of long repetitions in this discussion, some definitions are needed. These definitions and the discussion which follow them are not intended to be legally accurate, complete and exhaustive. To make them such would be exhausting and, practical-wise, unnecessary. Besides, this is not a legal treatise on Torts but a short talk among friends. Now for some definitions.

The Author*
***President**
Penna. Water Wks. Association

Negligence: "The failure to observe, for the protection of the interests of another person, that degree of care, precaution, and vigilance which the circumstances justly demand, whereby such other person suffers injury." (Cooley on Torts.) Negligence is also defined as "Any conduct which falls below the standard established by law for the protection of others against unreasonable risk of harm."

Standard of Conduct Established by Law: The standard of conduct to which one must conform to avoid being negligent is that of a reasonable man under like circumstances.

Reasonable Man: Reasonable man is a person exercising those qualities of attention, knowledge, intelligence, and judgment which society requires of its members for the protection of their own interests and the interests of others.

Unreasonable Risk: A risk which outweighs the value attached to the conduct which involves it. Illustration: A high pressure pipe line in a busy street may burst and cause damage. To operate such a pipe line, therefore, involves a risk. Its social value outweighs this risk and the placing of it is not conduct involving an *unreasonable risk.* On the other hand, allowing unchlorinated water to be distributed while repairing a chlorinator or because of a depleted supply of chlorine would be conduct involving unreasonable risk.

Negligent Conduct: May be either

(a) An act which the actor as a reasonable man should realize involves an unreasonable risk of causing an invasion of an interest of another, or
(b) A failure to do an act which is necessary for the protection or assistance of another and which the actor is under a duty to do.

Having gone a long way around the hill, let us look for a short cut. When, on principle, is a water works operator negligent? From the definitions this conclusion can be stated: A water works operator is negligent when his conduct brings an unreasonable risk of harm to his consumers or to persons or to property of others; and, when his conduct is not up to that standard of conduct, recognized by water works operators generally as required under like circumstances, to protect from unreasonable risk others to whom a duty is owed. Each operator is judged by a standard established by good practice. And standards of good practice are established by the consensus of opinion of such groups as this Association and others with similar objectives.

Some Legal Principles

Before there is a legal liability for damages in negligence cases certain elements must be present. A statement of these elements is needed.

First: Damages must have been suffered by some person.

Second: This other person must be one to whom the actor owes a duty of protection or assistance.

Third: The actor must have done or failed to do some act.

Fourth: This action or failure to act must have caused the damage.

Fifth: The action or failure to act must have involved an *unreasonable* risk to others.

Sixth: The action or failure to act must not have measured up to the standard of good practice under the circumstances.

Seventh: The failure to act must have been a failure to act in a way in which the actor was under a duty to do.

In short, before there is a legal liability for damages for negligence there must be negligent conduct resulting in damage to a third person to whom a duty is owed.

*This paper, presented before the Pennsylvania Water Operators Association, Sept. 3, 1941, is here reproduced by permission of the Association.—Ed.

Examples of Application of Legal Principles

With this background of definitions and legal principles, consideration will be given to three classes of cases in water works operation in which the principles are applied.

Damage Caused by Water Escaping from Mains

One of the frequent, but usually informal, complaints against a water utility is that a leaking or broken main floods and damages property. Claims based on such occurrences are not usually covered by public liability insurance, and if the utility is liable the damages collected are often considerable. For these reasons this class of damage will be touched upon briefly.

As was pointed out above, the maintenance and operation of a high pressure water main in a busy public street does involve the risk that water may leak from such main and cause damage to the property, or the persons of innocent people. However, since no other way has yet been found to get water to the places where it is needed in our cities, and since the water is needed at those places for the uses of industry, commerce, domestic life, and fire service, the social value of the service far outweighs the risk involved and the risk is therefore reasonable. That being true, the mere placing and operation of the main is not negligence. The water utility is not an insurer that its mains will not break or leak. *It is not liable for damages merely because water has escaped and caused the damage.* Negligence must be proved.

There have been cases, however, when liability has been imposed and damages paid. One important city paid a large claim when these facts were proved: The main was laid in a ditch below which there was a large sewer; the main was partly supported by timbers which were old and weakened when first installed under the main; known to the water works operators, many subcellars were below the level of the main and sewer; the ditch was opened several times to repair leaks caused by the sinking of the timbers and main; a large section finally broke; and water flooded adjacent cellars. Here we have a perfect example of negligence.

There was damage; the utility owed the duty to the person damaged of so installing and operating its main that no more than a reasonable risk would be involved; the operators of the water utility did not support their main; this failure of support caused the damage; the failure to properly support the main was failure to do what a reasonable man would have done under the circumstances. The conduct of the water works operator did not measure up to the standard of good conduct recognized by water works operators generally.

In another city a change in operating conditions as to pressure brought about a pipe line failure and a flooding of property. The line was designed for fifty pounds pressure and light class pipe had been installed. Many years later the system was rearranged and a pressure of one hundred and fifty pounds was put on the line. The line burst and damage was caused. There was negligence here because the act of placing that added pressure on a pipe line not designed to carry it was an act not up to the standard recognized by water works operators generally.

In another case a new line was laid. The street paving above the line kept sinking and at a lower level a "spring" developed. This condition continued for two years without an inspection of its main by the water utility. A major leak eventually developed and resulted in a flooding of cellars. The failure to inspect after the suspicious conditions developed was held to be negligent, as not being up to standard practice under the circumstances. Water works operators have long known the significance of "springs," which suddenly develop along a pipe line, as a suspicious condition which should not be neglected. It pays to locate and stop leaks.

Again, a known and serious leak was left unchecked for a period of twelve hours, during which no attempt was made to check it by closing valves or otherwise, and the flow of water increased due to the worsening of the blow out. The neglect in failing to attempt to stop the flow for a period of twelve hours, after discovery by the water utility, was deemed to be negligence.

It seems, therefore, that the mere fact of water damage from a leaking main is not enough to impose liability but that such liability is imposed when the water works operator has failed in the legal obligation to use the care and skill recognized as standard among operators generally, and when that failure caused injury and damage.

Water-Borne Disease

Ever since it became known that clear, cool, sparkling water, free of objectionable tastes and odors might yet be deadly as a carrier of typhoid and other water borne diseases, every water works operator has had the dread that some day, somehow, an epidemic would strike in his community for which his water utility would be found responsible. It may seem a contradiction in terms, but this very constant dread has been health-giving to ourselves and to our consumers. The dread has brought with it realization of great responsibility and a determination not to be found wanting. Our operators, our chemists, our bacteriologists, our engineers and our utility officers have all devoted their talents to the guarding of our public water supplies against disease. The State and Federal Health Departments have been efficient, resourceful, firm and untiring in the work. Its district engineers have been preaching the gospel of cleanliness, efficiency and constant care in every city and cross roads of our State. To all must go credit for the splendid progress that has been made in the last forty years. The battle has been won but the advanced positions must be held by constant attention to duty. We have a call to continued service.

A water works operator has the legal obligation to so operate his facilities that neither through his act nor through his neglect of a duty, lawfully imposed, will water borne disease bacteria reach his consumers. That is *his* obligation.

The water utility is not a guarantor of the quality of the water furnished and by selling it or by rendering water service it does not give an implied warranty that the water is free of harmful bacteria. The reason for this rule seems to be that the volume handled, its sources, the possibilities of contamination by persons or agencies over which the water utility has no control, all combine to make it unwise and unjust to require the utility to guarantee the water. The rendering of water service in great quantities does involve some risk but the risk is reasonable when weighed against the large social advantage of having water delivered by an organization which assumes the obligation of seeing to it that its operators measure up to the standards of such groups as this Association.

However, the water utility is liable for damages caused by negligence of its operators, and such liability has been imposed. Consider some instances.

Occasionally an ill advised operator thinks a little bad water will do no harm and be unnoticed when,

due to a break down, no other water is available. The sequel is usually a very sad story.

For twelve hours water was taken through an emergency intake from a highly polluted river. The normal source could not be used because of a break in a line. Deaths followed which were proved to have been caused by drinking water brought into the system from the river. Here was action below the standard and, therefore, negligent.

A chlorine machine broke down and water from a polluted source but clear, cool and sparkling, was, with the full knowledge of the water works operator, fed into the system. Deaths followed, and those deaths were caused by negligence. An operator failed to meet his legal obligations.

In other cases the water works operator used facilities in normal operation which were known to be faulty and in condition to permit pollution of otherwise good water.

In one city a splendid filtration and chlorination plant was in operation. Water from it was taken under very low head some distance through a buried conduit. The conduit was in ground subject to flooding by contaminated water and the conduit was known by the water works operators to have holes through its walls. By the standard of reasonable men in water works operation the conduct of these operators was below par. Negligence resulted in epidemic.

In another case the water works operators of a utility knew that the casing of a water well was bad and that impurities might reach the water through such defective casing. They continued the well in use and were negligent.

Water Safe at Source, Contaminated in Distribution System

The cases which have been brought forward up to this point were cases in which the water works operator failed to live up to his legal obligations in using reasonable care in putting water into the distribution system of the water utility. Under such conditions, the other essentials being proved, the utility would be liable for damages. There are a number of old cases and some new ones where the contamination came into the distribution system after the water left the source. There are some interesting variations of principle in these cases, and further possible variations which deserve thought. The illustrations which follow are in part imaginary but could happen.

A city has two systems for water service. One is high pressure, non-potable, for fire service. The other is high quality potable water. To operate drawbridges in the city and to guard againt delays due to possible failure of one system both systems are connected to water driven pistons operating the drawbridges. A valve at each piston was supposed to keep the fire service water out of the lower pressure potable system. Some water works operator forgot to install one of these valves. Many complaints of bad water came from the district near the bridge where the valve was missing. These complaints were heard but unheeded for months until an epidemic developed and pollution of the supply was proved. Here there was negligence on the part of the operator who failed to install the valve; negligence on the part of the operator who conceived of the idea in the first place; and gross negligence on the part of the water works operators who failed to make any investigation as to the cause of the bad water in the neighborhood. None of them lived up to the standard.

Again a case of two systems, one potable and the other high pressure non-potable fire service. Here a cross connection had been ordered removed, but, instead the connecting valve had been merely closed. This cross connection valve was opened by mistake and bad water was let into the potable supply system. After unexplained conditions indicated that something was wrong nothing was done to warn consumers for a number of hours. An epidemic developed. There was negligence in failing to remove the cross connections when ordered, there was negligence in opening the old cross connection, there was negligence in failing to warn consumers when the suspicious conditions developed.

In another case the water utility has knowledge of the existence of a cross connection within a mill or factory. The cross connection is installed by and for the convenience of the mill company. Under orders of the health authorities it is so valved as to normally prevent water passing from the mill supply to the water utility system. All goes well until some person in the employ of the mill by-passes the properly valved by-pass and contaminated water reaches the system of the utility.

Has any water works operator failed to perform a legal obligation in such a case? Consider several matters in this connection. The cross connection was solely for the benefit of the mill and was on mill property and was installed and controlled by the mill. The water utility had no legal control over it. It was installed with the knowledge of the public health authorities and in accordance with their requirements. The cross connection was opened by one over whom the water utility had no control. If there is nothing more to the case than this it would be very difficult to prove negligence on the part of any water works operator.

If, however, it develops that the cross connection has been open for several months and has during all that time been putting polluted water into the system, and if it further develops that during all that period the water works operator failed to collect system samples in the district where the supposedly closed cross connection was known to be, and examine them for evidence of contamination, then I think it possible that there was negligence. It is probable that a reasonable man, a good water works operator, would think he had a legal obligation to police his own distribution system in the neighborhood on the off chance that some mill hand might open the by-pass and cause serious damage.

The legal obligation would probably be different if the existence of the cross connection were absolutely unknown to the water works operator. In such a case there would be little, if any, reason to think that system samples should be collected in that particular section. Water works practice probably indicates that, as a reasonable man, a good operator should collect system samples more frequently in regions where known conditions indicate potential dangers, but only representative samples where no known danger spots exist.

Unjustifiable Obligations Recently Expected

This matter is mentioned because of a tendency on the part of public health authorities in some states (not Pennsylvania) to attempt to impose on water utilities what appear to be unjustifiable obligations. These authorities, knowing that cross connections are hazards, even though sealed and valved, and knowing that faulty domestic plumbing may cause localized contamination through back-siphonage, and knowing that some consumers have private well supplies of doubtful quality, are seeking to impose on water works operators the obligation of policing

the premises and of inspecting the plumbing of all of the consumers attached to the lines of the water utility.

Such an obligation ought not to be assumed. The water utility probably has no legal right to make the inspection and it certainly has neither the money nor the ability required to make the original exhaustive and complete surveys, thereafter, periodic inspection at frequent intervals, which alone could give real protection. By once assuming such an unjust obligation the water works operator may possibly find one day that he is being held negligent in failing to do thoroughly that which he had unwisely undertaken to do. Good water works practice certainly indicates that it is better to do well that which water works operators have the legal obligation to do—police their own systems and facilities—than to raise a false sense of security by half doing that which they have no legal obligation to do.

CASTOR BEANS

As an Emergency Crop for Sewage Irrigated Land

By W. D. STAPLES, M.S.
Sanitary Engineer
Brazos County Health Unit
BRYAN, TEXAS

NOW is the time for all good sewage plant operators to come to the aid of their country.

Castor beans are the source of castor oil which, in the last war, was used to lubricate airplane engines and artillery guns. The present emergency should cause a sharp increase in the demand for this oil. The crops in this country are limited because the castor beans have been considered a soil depleting crop and they have been cheaply imported. In consequence, little interest has been taken in their development but, with a possible shortage of shipping the crop may attract more attention than heretofore. This is an ideal crop for growing on land fertilized by sewage plant effluents because the effluent will supply moisture, nitrogen, phosphoric acid, and potash, which is removed from the soil by these plants. There is no danger of contamination from the effluent because the beans must be processed before being used.

When irrigation with sewage effluent is properly conducted it protects the streams against pollution while producing crops. Since the sewage water is needed most for crops during dry summer weather, when streams are generally at their lowest flow, it is the ideal period in which to reduce stream loadings and irrigation seems the practical solution to two problems simultaneously.

Castor beans, beside playing an important part as a lubricant in the rearmament program, are being developed for use as oil for paints, varnishes, and lacquers. Other products from the plants may be developed for use in insecticides, etc., so that when the national emergency is over there may well be a commercial demand for the beans. This crop seems well suited for sewage irrigation, and the products are not in as highly a competitive field as cotton, of which we have more than ample supply.

The plants do best in the southern states where they have a warm climate and longer growing season. The land is prepared in the same manner as for corn, and may be planted by a corn planter with specially prepared plates. The time of planting varies locally, and corresponds to that of cotton. The rows should be about six feet apart and the hills about four feet apart. The beans are planted from one to two inches deep. It is advisable to call on the State Agricultural Experiment Station for information on seed so as to be sure to secure the oil-producing variety instead of the ornamental variety, and to get details of cultivation. The most desirable beans run from 1500 to 2500 per pound and weigh about forty-six pounds per bushel.

"The castor-oil plant is not known to be poisonous, and although the leaves are not relished by farm animals, they are said to be used in India as fodder for cattle. Castor beans, however, contain a poisonous principle, and though harmless when handled, may cause serious, if not fatal, effects when eaten, especially in the case of small children. Care should be taken to prevent the beans from being accidentally mixed with the grain fed to animals, since many cases have been reported in which the death of horses has been due to eating feed in which they have become mixed." [1]

Sewage plant operators have long needed a safe and profitable crop to grow on irrigated lands, and if one is found more irrigation will be practiced in sewage treatment. Since irrigation takes the pollution out of the streams, this method of disposal, where practical, may be expected to be used more and more. The cost of treatment could also be reduced, because it would not be necessary to give as complete treatment, and a profit could be made from the sale of the beans.

Since the United States imports annually several million bushels of castor beans for the production of castor oil, it would seem worth while to look further into the possibility of developing this crop as a sewage treatment by-product and provide, thereby, a home supply of castor oil for the nation's need.

REFERENCES:

(1) *Castor Beans*, by W. W. Stochbereger, Bureau of Plant Industry, United States Department of Agriculture.

(2) *Experiments with Castor Beans in Texas*, by E. B. Reynolds, 663 Progress Report, Texas Agricultural Experiment Station, A. & M. College of Texas.

SEWAGE WORKS CONVENTION PROGRAM ALL SET

39 Firms Take Exhibit Space for New York Show, Oct. 9-11, at Hotel Pennsylvania

THE technical program of the 2nd Annual Convention of the Federation of Sewage Works Associations has been completed and copies mailed out to all members.

It will be noted that plant operation and maintenance is featured. One entire session is devoted to a symposium on operating problems, and on the closing day the best part of the forenoon is devoted to the Operators "Turn-Table" in which operating problems will receive more airing. In the afternoon a trip of inspection to New York City's newest Treatment Plants has been arranged.

We regret to find some names and topics missing from the final program which the Program Committee had on the tentative copy reviewed in our August issue. We therefore call our readers' attention to the completed program which follows.

Technical Program
Thursday, October 9
Inspection of Exhibits

Greetings from New York City—Hon. Irving V. A. Huie, Commissioner of Public Works, New York City.

Operating Experiences in New York City—Richard H. Gould.

Luncheon

Design of Sewage Works to Facilitate Operation—Stuart E. Coburn.

Effect of Load Distribution on Activated Sludge Process—Gordon M. Fair and John E. McKee.

Laboratory Study of the Guggenheim Process—Earle B. Phelps and John G. Bevan.

Utilization of Sludge Gas in Moderate Sized Sewage Treatment Works—George Martin.

Evening Smoker and Entertainment (Stag)
Friday, October 10

National Defense Aspects of Operation of Sewage Works—Warren J. Scott.

Operation of Small Pumping Stations—Grant M. Olewiler.

Industrial Wastes in Pollution Control Programs—Milton P. Adams.

Elements Influencing Vacuum Filtration of Sludge—A. L. Genter.

Federation Luncheon

Guest Speaker — Hon. Walter D. Binger, Commissioner of Borough Works.

The Control and Operation of Sewage Works (a symposium)—C. C. Larson, Leader.

a. Standards of Successful Operation—Charles Gilman Hyde.
b. Biological Filters—M. W. Tatlock.
c. Sludge Digestion—Guy E. Griffin.
d. Screening, Handling, and Disposal—Wellington Donaldson.
e. Cold Weather Operation—Albert E. Berry.
f. Records—Roy S. Lanphear.

Annual Dinner, Dance and Show
Saturday, October 11
Federation Breakfast
(Everybody Welcome)

Operators' Turn-Table — LeRoy W. Van Kleeck and B. A. Poole, Leaders.

Business Session.

Buffet Luncheon—Assembly of Regional Associations
Inspection Trip: Sewage Treatment Works of New York City

Entertainment

It will be noted that entertainment provided for is essentially the same as that enjoyed by those attending the Chicago convention last year.

First Evening—Smoker and Show (Stag).

Second Evening — Dinner-Dance and Show.

Two luncheons are scheduled, at one of which the ladies will join the men if they so desire. For the ladies, a luncheon and sight-seeing trip has been arranged for the first day. On the second day, a Tea and Fashion Show in the afternoon and the Dinner-Dance in the evening. Thursday evening, Oct. 9th, is left open for the ladies, who may wish to attend the theater, while the Stag Smoker is occupying the attention of the men.

For those who arrive the day or evening before the convention formally opens on Thursday, the 9th, a "Get-Together" is being arranged in the Hotel Pennsylvania. For the benefit of those who may not know what a "Get-Together" is, it is just a congregating place where one fellow can find another, swap shop talk, play a game of bridge, quaff a wee bit of ale, and spin a yarn. It's just a good way to start off a convention, offering a chance to meet old acquaintances and make new. It's the Convention Management Committee's "open-house" and all early arrivals will find it interesting to drop in on the "Get-Together" after dinner or any time during the evening. And this includes the ladies, too.

Registration Fee

A registration fee of $4.00 has been fixed for those (men or ladies) who expect to attend all functions of entertainment. For those who wish only to attend technical sessions and purchase separate tickets for the entertainment (or purchase none) the simple registration fee is $1.50.

Exhibits

To date, Sept. 10th, the following 39 firms have taken exhibit space and amongst these exhibitors it will be noted that five firms are exhibiting this year who were not represented at the 1940 convention.

*Aluminum Company of America
*American Brass Co.
*American Cast Iron Pipe Co.
*American City Magazine
American Rolling Mill Co.
*Carson-Cadillac Co.
*Carter, Ralph B., Co.
*Chain Belt Co.
*Chapman Valve Mfg. Co.
*Chicago Pump Co.
*Crane Company
*Dorr Company
Electro-Rust-Proofing Co.
*Engineering News Record
*Fairbanks-Morse Co.
Flexible Sewer Rod Co.
*General Electric Co.
*Homelite Corp.
*International Filter Co.
*Johns-Manville
*Lakeside Engineering Corp.
Limestone Products Corp.
*Link-Belt Co.
*Mathieson Alkali Works
*Monsanto Chemical Co.
*Nichols Eng. & Research Corp.
*Pacific Flush Tank Co.
*Pittsburgh Equitable Meter Co.
*Merco-Nordstrom Valve Co.
*Public Works Magazine
*Royer Foundry & Machine Co.
*Sewage Works Engineering
*U. S. Pipe & Foundry Co.
Vapor Recovery Systems
*Wallace & Tiernan Co.
*Water Works & Sewerage
*Wood. R. D., Co.
*Yeomans Bros. Co.

*Firms which exhibited at the 1st Federation Convention, Chicago, 1940.

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All the Advantages of Centrifugal Pumps Without Disadvantages of Small, Scaled-Down Pumps or Inefficient, Troublesome Substitutes

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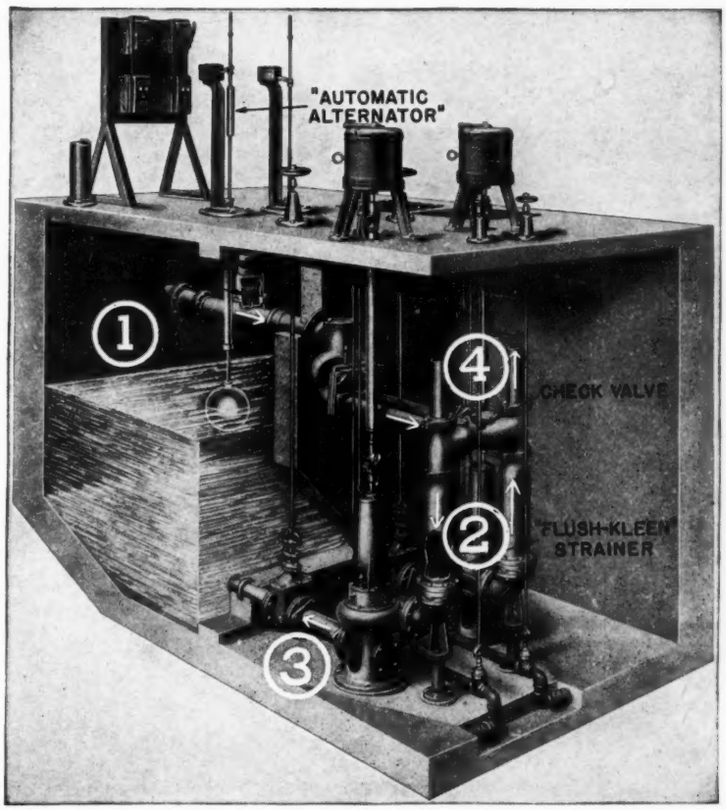

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FILLING WET WELL

① Sewage flows through inlet pipe.
② Coarse sewage matter is retained by strainer.
③ Strained sewage flows through idle pump to basin.

PUMPING

③ Strained sewage is pumped from basin.
② Coarse sewage matter is backwashed from strainer.
④ Special check valve closes; sewage and coarse matter are pumped to sewers.

Both pumps operate under peak flows.

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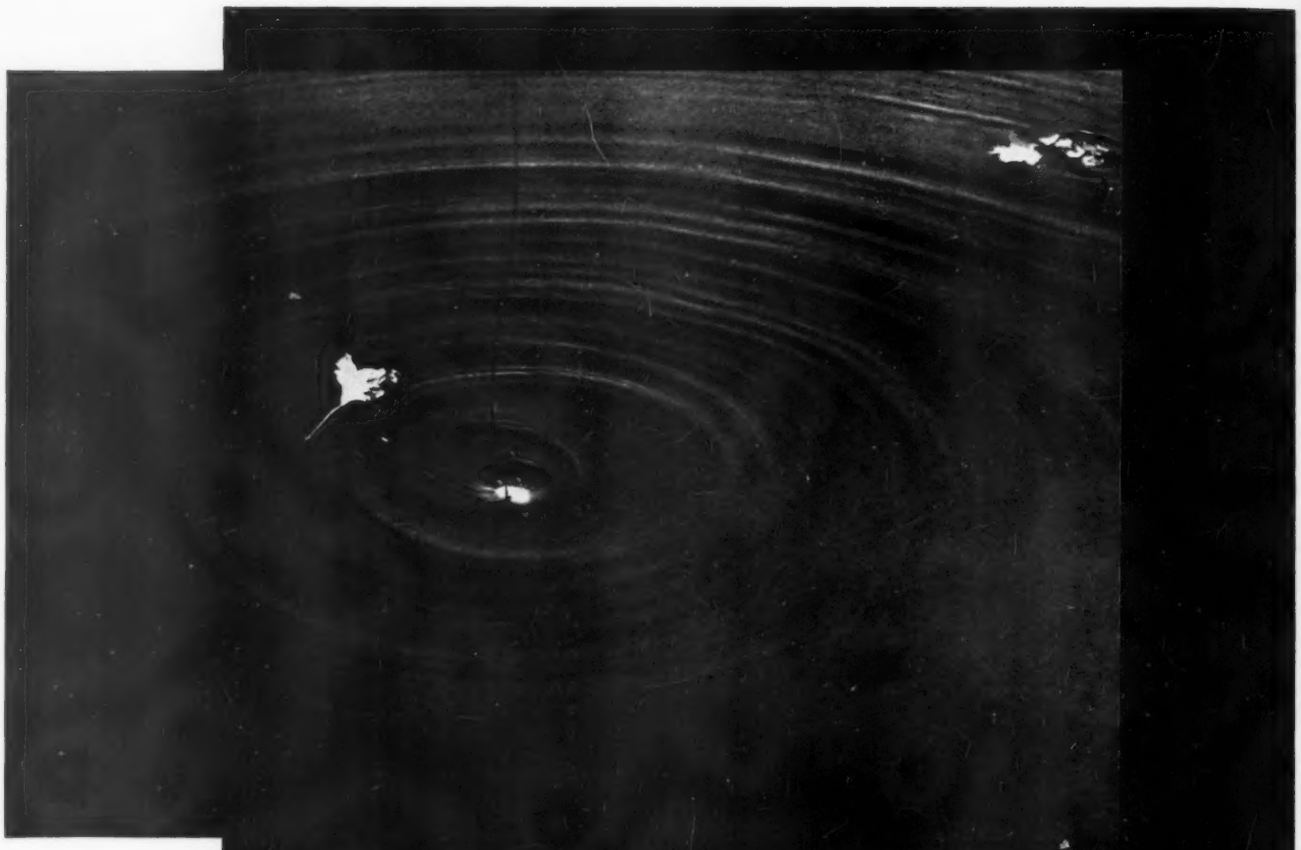
FIRE — HOUSE — SEWAGE — SCRU-PELLER PUMPS
AERATORS—COMMINUTORS—SAMPLERS

REPRESENTATIVES THROUGHOUT THE UNITED STATES AND FOREIGN COUNTRIES



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Year	No. of Plants	Year	No. of Plants
1930	15	1936	870
1931	127	1937	957
1932	374	1938	1128
1933	515	1939	1172
1934	662	1940	1195
1935	760	1941	12—

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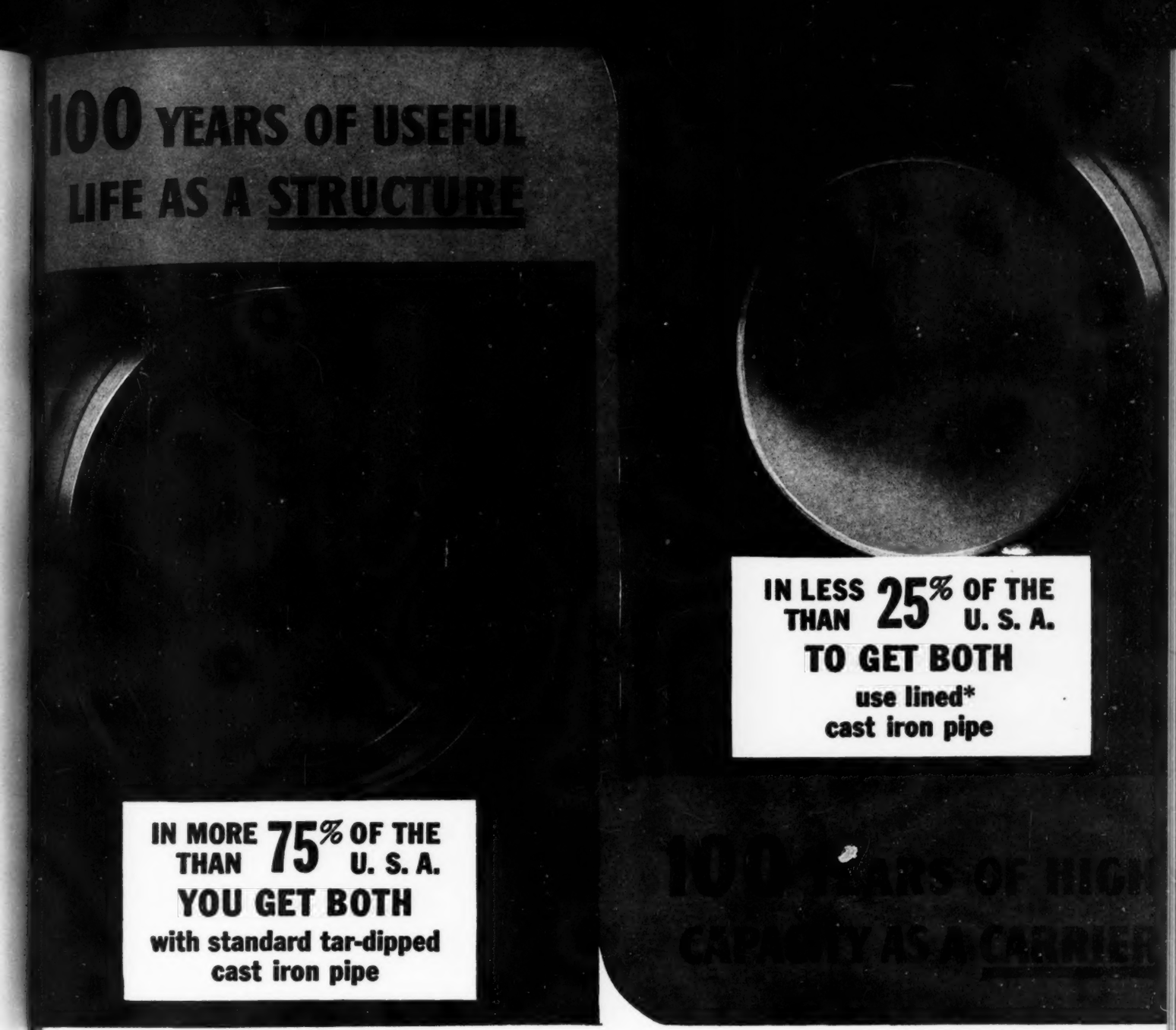
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use lined*
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IN MORE THAN 75% OF THE U. S. A.
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cast iron pipe
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ELIMINATION OF GAS HAZARDS AT SEWAGE TREATMENT PLANTS

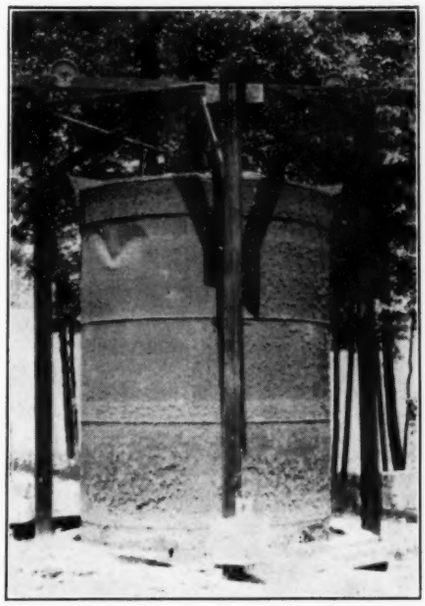
And Elements of Design in Gas Handling and Utilization Systems

By The Engineering Department
PACIFIC FLUSH-TANK COMPANY
CHICAGO, ILLINOIS

SEWAGE sludge gas, until comparatively recently, an unwelcome source of odor nuisance, is rapidly becoming the long sought "by-product" which will place sewage treatment more nearly on a self-supporting basis. But the utilization of sewage gas as a source of heat and power may prove very costly unless we consider and eliminate the hazards introduced in harnessing this previously wasted source of power.

History

Sewage sludge gas was collected and used for cooking and heating in this country as early as 1915 when C. C. Hommon covered the gas vents of the Imhoff tanks of the Peachtree Plant at Atlanta, Georgia, but the utilization of sewage gas was not considered practical until after the advent of heated separate sludge digestion tanks. Since the first heated sludge digestion installation in this country at Antigo, Wisconsin (1926) the development of this type of sludge digestion with provision for heating and control has made possible a constant supply of sewage gas unaffected by seasonal temperature changes. In present practice, the utilization of this by-product of sewage treatment is one of the most important economic considerations in the design of the modern sewage treatment plant. The safe utilization and nuisance free burning of sewage gas must be considered regardless of the size of the treatment plant.



Atlanta's Relic

This historic gas-holder, until recent years still standing at Atlanta's Peachtree Creek Plant, stored gas from Imhoff tanks. Represented the first attempt at utilization of sewage gas, which was used in the home of C. C. Hommon, then plant superintendent, for heating and cooking.

Uses of Sewage Sludge Gas

Engineers and operators are almost daily finding new uses for sewage sludge gas; as at Old Greenwich, Connecticut, where the operator uses sewage gas to operate the laboratory refrigerator. But the principal uses at the present time are to provide heat for the buildings and to maintain the temperature of the digester, and to develop power with gas engines. The operation of gas engines either to generate electrical energy, or as prime movers directly connected to pumps or air blowers, is accepted practice in all of the larger treatment plants, and to an increasing extent in moderate to small sized plants also.

The Coney Island plant at New York City, one of the earlier suc-

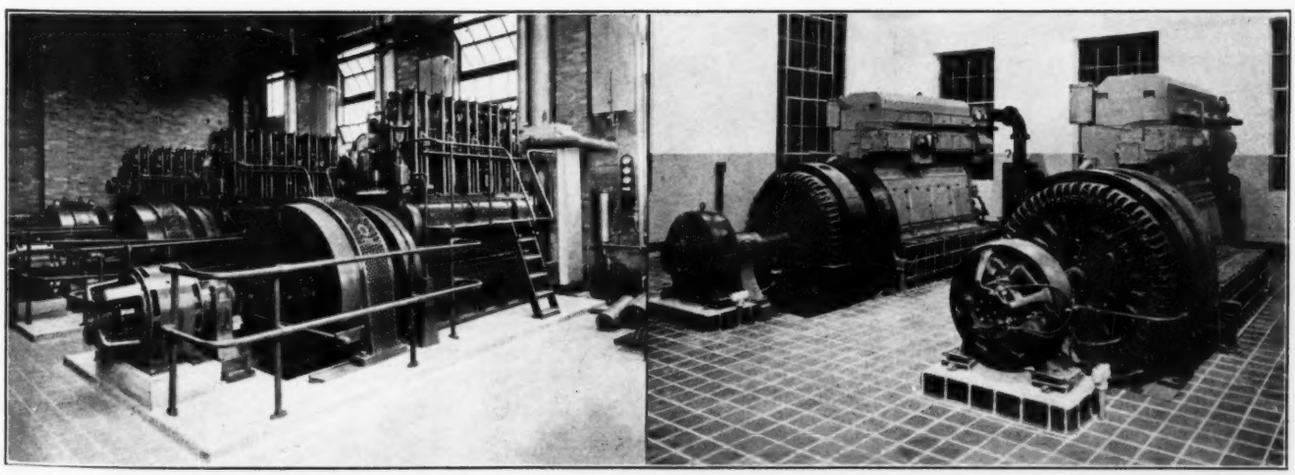


Fig. 1—Representative Gas Engine Installations, Coney Island, N. Y. (1936 Worthington) and Durham, N. C. (1935 Cooper-Bessemer)

Both having demonstrated their value and dependability of service as amongst the earlier installations.

Fig. 2—Damage to Digestion Tanks at Woonsocket, R. I., by Explosion

cessful installations, is now being extended and will incorporate 10 gas engines developing 6000 H.P. to generate power and operate direct connected blowers. A recent survey[1] indicates that gas engines aggregating over 35,000 H.P. are now in operation in the U. S. Quite a number of operators have written articles indicating that gas engines have paid for themselves in from 3 to 5 years due to the savings in power cost. Probably one of the outstanding examples of a profitable gas engine installation is at Fort Dodge, Iowa, where the city has an agreement with the power company which enables them to buy or sell electrical energy to the power company at the same rate. A 275 H.P. gas engine direct connected to a generator which "floats" on the power line feeds back to the power company's system when the plant demand is less than the output of the generator. During the fiscal year ending March 31, 1941, the city of Fort Dodge received a revenue from the sale of power of $6,620.00. In addition, sewage gas supplied all power for the operation of the plant, including pumping all sewage, compressing air for preaeration, and grease removal, lighting, etc., and the building and digester heating requirements. The cities of Des Moines, Iowa, and Waterloo, Iowa, have a novel contract arrangement whereby they sell to the local gas company all gas in excess of that required for normal gas heating uses. This gas is in turn mixed with city gas by the utility and sold back to the city consumers. The city of Des Moines, during the period from Aug. 1, 1940, to July 31, 1941, received $18,472 from the sale of excess gas. Sewage gas is used at quite a number of plants for providing auxiliary heat in incinerators burning sewage screenings and sludge, or for the joint disposal of garbage and sludge. These few examples indicate the variety of new methods of utilizing the sewage gas, which have introduced new problems which must be considered in connection with sewage treatment plant design and operation.

These problems are receiving considerable attention by State Health Departments and various sewage works associations and insurance underwriters. For example, the joint committee representing the New Jersey Sewage Works Association, the Fire Underwriters, the New Jersey League of Municipalities and the New Jersey State Department of Health, has formulated a set of recommended principles for the safe design and operation of gas handling equipment at sewage treatment plants.[2]

It is the purpose of this paper to better acquaint designers and operators of sewage treatment plants with the hazards involved in gas utilization systems and discuss the principles and applications of the various safety devices. It is only through the full appreciation of the dangers involved and knowledge of means for ample protection that the safe utilization of gas may be assured.

Fig 3.—Damage to Control Chamber and Imhoff Tanks at Dayton, Ohio, by Explosion

Explosion Hazards

Quite often designers or plant operators will ridicule the dangers in connection with the handling and utilization of sewage gas, saying . . . "It has never happened in any plants that I have designed or operated," or, "There are hundreds of plants built without a great deal of regard for protective measures that have operated without any trouble."

But let's review the record—there have been relatively few explosions at sewage plants but the magnitude of those of record (and resultant loss of life) indicate that —"It can happen here."

We might make reference to many reported explosions in sewer systems caused by volatile substances entering the sewer and being ignited, or of loss of life due to toxic or other gases in sewers—but the purpose of this discussion is to consider hazards more directly associated with the treatment process and gas collection and utilization. A few examples of serious explosions attributed to gas generated in the treatment process include:

Ocean Grove, N. J., April 25, 1915

This explosion and fire in a digestion (septic) tank occurred during the inspection of the treatment plant by a group of municipal officials from another town and cost the lives of two of the visitors and severely burned another.

Causes—Air and gas mixture in tank.
Careless visitor with match.

Moral—Eliminate air-gas (explosive) mixtures.
Do not allow unattended visitors.
No open flames near gas producing tanks.

Woonsocket, R. I., October 2, 1931[3]

An explosion occurred in partially empty digestion tanks which had been entered by two workmen for inspection of a mechanism. The violence of the explosion, which cost the lives of the two workmen, is evident from the photograph in Fig. 2.

Cause—Air and gas mixture in tanks, but method of ignition unknown.

Moral—Recently emptied tanks should not be entered unless completely purged of gas, nor entered during transfer of sludge. Actively digesting sludge should not be transferred from one tank to another which contains air. (Displacement of liquid is safe method.)

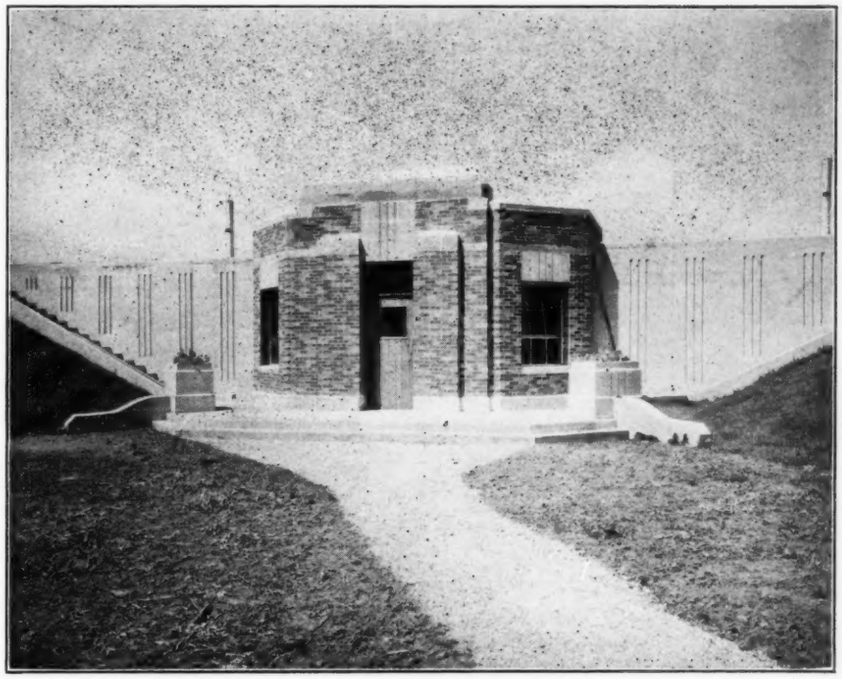


Fig. 4—Digester Control Chamber at Muskegon, Michigan.

Collingswood, N. J., March 5, 1935

A similar explosion occurred in a digestion tank at Collingswood, caused by air being drawn into the tank when sludge was being withdrawn, producing an explosive mixture.

Moral—Keep a positive gas pressure at all times. With a fixed covered tank displace sludge to be withdrawn by new liquid added.

Bristol, L. I., N. Y., February 13, 1936[4]

This explosion occurred in a control house at night when no one was present. It was the consensus of opinion of investigators of the explosion that it was caused by the use of a water seal type of pressure relief of home-made design from which the water was blown, thus allowing gas to escape into the building. The resultant explosive mixture was assumedly ignited by a coal-fired boiler.

Moral—Eliminate water seal traps. Rely upon specifically designed and tried relief and flame trap units.

Dayton, Ohio, November 12, 1938[5]

By happening at night between visits of the operator on duty, a violent explosion of sewage gas at the Dayton, Ohio sewage treatment plant luckily did not injure anyone. The photograph in Fig. 3 shows the violence of such explosions. This one occurred in the operating gallery between batteries of Imhoff Tanks. Accumulations of gas in the gallery were assumedly ignited by gas heaters in the buildings at the ends of the gallery. Although the damage was so great as to make it impossible to determine the source of the escape of gas, it was indicated that water seal type "running traps" were most probably responsible.

Moral — Eliminate water seal traps.

Other examples of explosions would include:

Marshfield, Wisconsin—where an explosion in a fixed covered digester lifted and shattered the entire top slab. The operator in an adjacent building was hurled to the side of the building and shaken up, but, fortunately, was not seriously injured.

Burlington, Wisconsin

All of the windows of the control building housing the gas boiler and control equipment were blown out when a liquid seal trap lost its water seal. An independent well water supply for the plant necessitated the operation of a pump to provide the water for the plant. In order to economize, the water to provide the water seal on the flame and relief trap was shut off. As a result, gas escaped into the control chamber through the depleted water seal. A coal-fired boiler undoubtedly ignited the mixture. This explosion occurred during the night when no attendant was present.

Iowa City, Iowa

Considerable damage was caused to the pump house at this plant by a gas explosion probably caused by

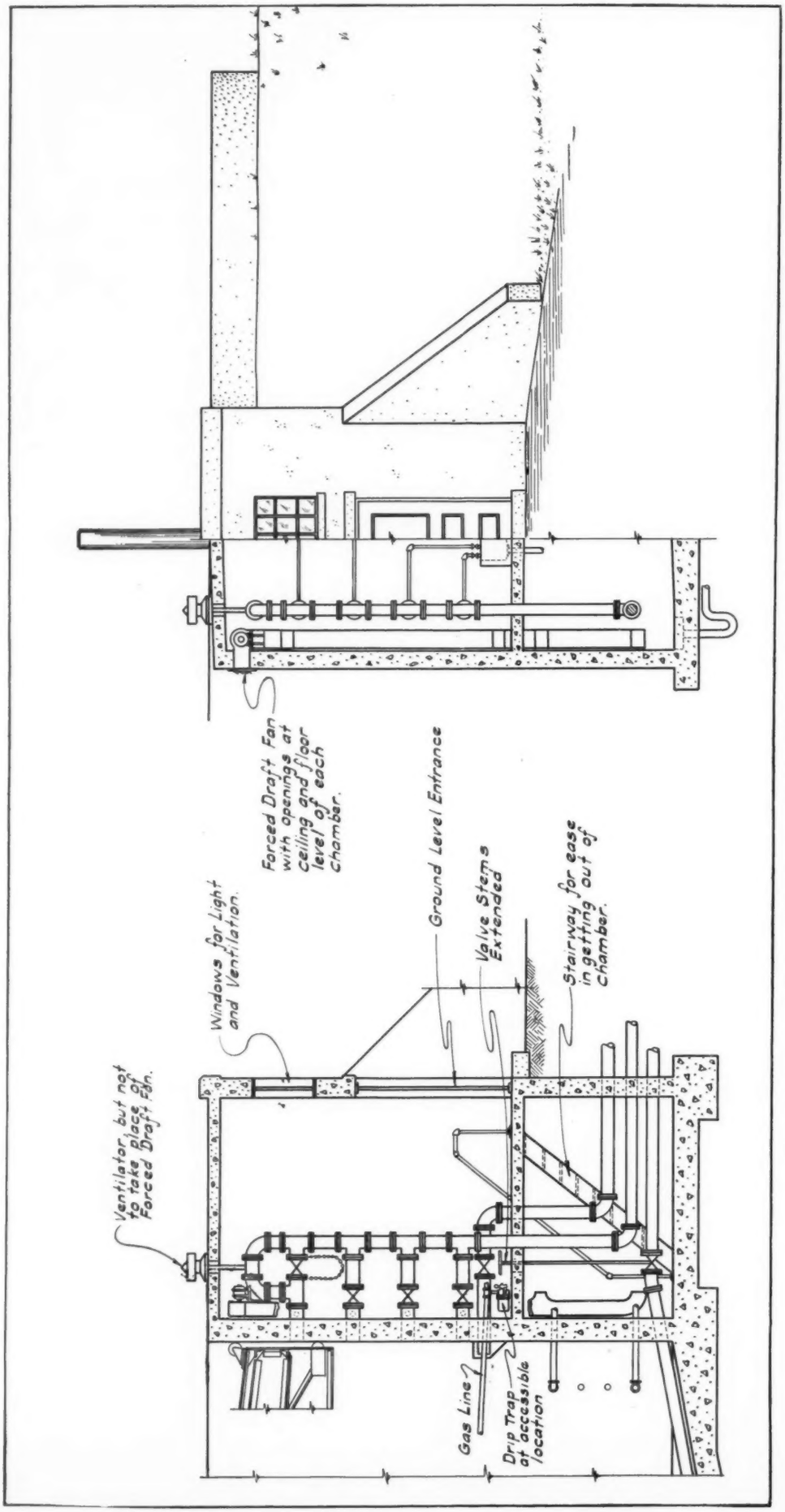

Forced Draft Fan with openings at ceiling and floor level of each chamber.
Ground Level Entrance
Valve Stems Extended
Stairway for ease in getting out of chamber.
Windows for Light and Ventilation.
Ventilator, but not to take place of Forced Draft Fan.
Gas Line
Drip Trap at accessible location

Fig. 5—Sections of Control Chamber for Single Digester, Showing Features for Utmost Safety

the failure of the thermo-pilot of the gas boiler, allowing unburned gas to escape into the building. No one was in the building at the time of the explosion. Proper maintenance of boiler controls might have prevented this.

Watertown, Wisconsin

An explosion in the pump building due to gas accumulations from a basement sump, which received gassing sludge from the digester, resulted in damage to the building but no personal injury. The possible recurrence was eliminated by covering and venting the sludge sump to the outside atmosphere.

Other Hazards

Although explosions are quite spectacular and the damage easy to see, there also has been loss of life due to toxicity or suffocation by gas in chambers. One of the most notable examples, and one at which one of the authors was almost an eye witness, is:

Lima, Ohio, May 4, 1932[6]

A designing engineer sacrificed his life in attempting to rescue a plant operator who was descending a ladder into a control chamber adjacent to a digestion tank and was overcome by gas which had lodged in the chamber. The designing engineer was found to have inhaled even greater quantities of the fatal H_2S (hydrogen sulphide) gas than had the operator. This because of the fact that he was out of breath from running to the rescue when he entered the chamber and was breathing hard and deep.

(The design of digester control chambers discussed later covers means of preventing such tragedies.)

The above examples seem to be the best answer to skeptical designing engineers and plant operators who might be inclined to scoff at the dangers in connection with sewage gas. If a disaster should come, it is well for a designing engineer to be able to say—

> "All of the protective measures and best design principles known at the time the plant was designed and constructed were provided."

How much better this, than to be criticized or held responsible for great damage or loss of life by having it indicated that known protective devices were not employed. Persons do not scoff at taking out fire insurance because they never had a fire, nor life insurance because they never died.

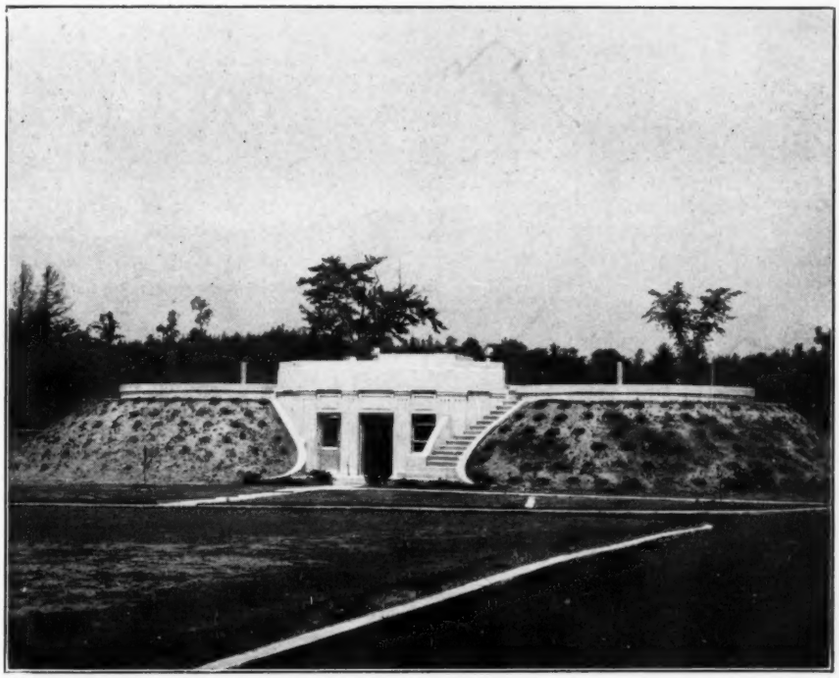


Fig. 6—Digester Control Chamber with Separate Room at Left with Separate Entrance from Outside. Indian Orchard Plant, Springfield, Mass.

Composition of Gas

In order to better understand the problems involved in the handling of sewage digester gas we might briefly consider its composition. The constituents of the gas will depend somewhat upon the characteristics of the sewage solids being digested and the conditions of digestion. Essentially, it will consist of a mixture of methane and carbon dioxide, with traces of hydrogen and nitrogen. In some cases, hydrogen sulfide, carbon monoxide, oxygen and traces of other gases will be present. The two main constituents, methane and carbon dioxide, in most cases will make up better than 90 per cent of the gas. It might be interesting to note that the richness of the gas, that is, the percentage of the methane present, is quite dependent upon the condition of digestion. In the initial operation of any digestion tank, gas will be produced which may contain as much as 60 or 70 per cent carbon dioxide. Carbon dioxide is produced in the first or acid stage of digestion and a suitable gas for burning will not be produced until the second (alkaline) stage of digestion has proceeded sufficiently to increase the methane content of the gas. A normal gas will contain from 60 to 75 per cent of methane, and have a heat value of from 550 to 800 B.T.U. per cubic foot.

Nature of Gas Hazards

Gas hazards might be divided into the following classifications: (a) *Explosion.*

Mr. L. W. Morrill (2), Secretary of the Gas Hazards Committee of the New Jersey Sewage Works Association, aptly defines the subject as follows: "Any explosion is the result of 4 factors: the presence of an inflammable gas, oxygen, a proper mixture of the two and a source of ignition. Eliminate any one of these and there can be no explosion. At the sewage plant, gas and atmospheric oxygen are, of course, always present, but the gas will not burn or explode unless diluted with oxygen supplying air. Because sources of ignition are so numerous, and to a large extent unpredictable, it is accepted practice to consider them as uncontrollable within limits of absolute safety. Fortunately, one can control the formation of explosive mixtures of gas and air by the simple expedient of keeping them separated."

In a report of tests made by the Underwriters' Laboratories, Inc., it is stated that the flammable range of methane (principal constituent of sewage gas) in air is from 5.6 to 13.5 per cent by volume and that the flame speed and intensity is a function of the concentration, being at a maximum at a concentration of about 9.6 per cent and at a minimum when the concentration of methane is near either of the limits of the range previously mentioned.

(b) *Burning*

When the percentage of gas as compared with air is high or above the limit mentioned above, a "burning" mixture is encountered. Such a mixture is not as dangerous as an explosive mixture since it may be extinguished if encountered. However, sewage plant workers have been seriously burned by an instantaneous flame "puff" that couldn't be termed an explosion.

It is important from the standpoint of flame trap design to take these burning mixtures into consideration as will be discussed under the discussion of "Protective Devices."

(c) *Toxicity*

Of the minor constituents of sewage gas, hydrogen sulphide (H_2S) is the most important. For the most part it comes from the sulphates in the liquid portion of sewages and industrial wastes.

This gas is deadly when present in sufficient concentration as shown by the following:[7]

Fatal in 30 min. or less.....	0.06 to 0.10%	(600 to 1,000 p.p.m.)
Severe illness caused ½ to 1 hour.....	0.05 to 0.07%	(500 to 700 p.p.m.)
No severe effects if exposed for ½ to 1 hour	0.005 to 0.01%	(50 to 100 p.p.m.)

Concentrations of hydrogen sulphide higher than 2,000 ppm. (0.2 per cent) cause almost immediate cessation of breathing, resulting from total paralysis of the respiratory center. It is well to reflect upon the fact that hydrogen sulphide has about the same lethal power as hydrogen cyanide (HCN) gas, always considered the most deadly of gases. Although in lower concentrations hydrogen sulphide has a very repulsive odor which may serve as a warning, at lethal concentrations the odor is not so pronounced and the effect of the gas paralyzes the nerve centers so that the odor is not detected by the victim.

(d) *Suffocation*

Although the other constituents of sewage gas such as carbon dioxide (CO_2) and methane (CH_4) have not the deadly effect of hydrogen sulphide, they tend to decrease the oxygen content of the air and cause asphyxiation. Man works best and breathes easiest when the air contains about 21 per cent of oxygen. Men breathing air that has as little as 15 per cent of oxygen usually become dizzy, have a rapid heart beat and suffer from headache.

Design Considerations

It must be agreed that the preceding discussion of hazards indicates that truly dangerous situations are present when handling sewage gas and that the design of structures and protective devices deserves the utmost consideration by the designing engineer. The designer must consider the probable inexperience of the operator at the start of plant operation and a disregard, leading to carelessness or neglect which may occur later on. He must also recognize that appointment of inexperienced operators may follow, after the first operator, which the designer may have been in a position to instruct effectively.

(a) *Digester Control Chambers*

Until recently the control chambers for digestion tanks consisted, generally, of a small rectangular structure entered from the top through a manhole or steel cover. Loss of life in such structures such as that reported for Lima, Ohio, under "Examples of Other Hazards," has caused engineers to give more consideration to the design of control chambers, and State Sanitary Engineers to make recommendations on minimum requirements for safe design. Some of the elements of a proper control chamber design include provision for the following:

Ground Level Entrance and Convenient Access

Control chambers adjacent to digestion tanks, or chambers which contain gas carrying lines and devices, should have convenient ground level access. It should not contain any manhole steps or ladders but in case access is required to another level, standard stairs or "ship type" stairs, at least, should be provided. With such an arrangement an operator who becomes partially overcome by gas, has a good chance of crawling out of the chamber on hands and knees, while the additional exertion of climbing a ladder, even if possible, would increase the amount of toxic or asphyxiating gas he was breathing and lessen the chance of escape. Rescue operations are also simplified. Windows should also be provided for light and ventilation. A typical example of a properly designed control chamber is shown in Fig. 4.

It is also well to design those portions of chambers which lie below the elevation of the ground level entrance so that the operator need not enter such portions in normal operating routine. Valve stems can be extended to the main floor for controlling any valve in the lower portion. The lower portion of such chambers should not be entered unless a companion is present and remains in the upper portion, or unless tests indicate ample safety in entering. Both are preferable.

Forced Draft Ventilation

All control chambers where gas might escape or accumulate should be provided with a forced draft fan arranged so that an intake is placed at the floor and ceiling of each floor level. (See Fig. 5.) Such fans should have sufficient capacity to completely change the air in the chamber every 2 to 3 minutes. Fan motor should be wired to a switch at the *entrance* to the chamber, which switch also controls the lights so that the operator must put the fan in operation when he turns on the light on entering the chamber.

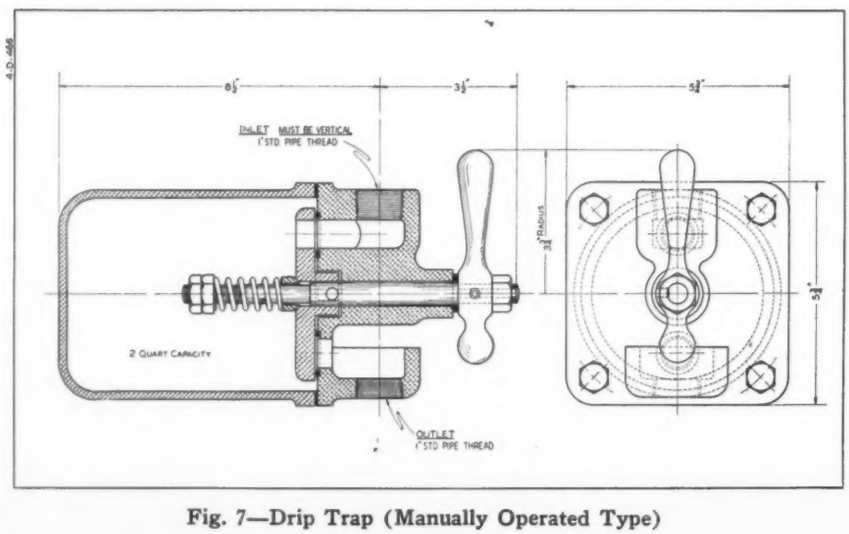


Fig. 7—Drip Trap (Manually Operated Type)

Natural draft ventilators are not satisfactory due to limited capacity and the fact that some of the gases, notably carbon dioxide, are heavier than air and are not removed from the lower portions of chambers except by forced draft.

A suitable gas mask (with cannister scaled off) might well be kept in the control chamber so that it will be available, if needed. The hose type mask is always the safer because no cannister mask is protective in the absence of oxygen.

Separate Gas Control Building

With the increasing attention given to the dangers of sewage gas about the treatment plant, some State Health Departments and insurance underwriting boards are recommending the use of a separate isolated building, built entirely above ground level, to house flame traps, meters, boilers and other gas appurtenances. At Green Bay, Wisconsin, the State Board of Fire Underwriters required all gas meters, flame traps, gas compressors and controls to be placed in an isolated chamber *accessible only from an external ground level entrance.* It is possible to accomplish practically the same degree of protection, however, by designing a separate room, as a part of the control chamber adjacent to the digester, to house gas appurtenances. Such a room should have an entrance to the outside, independent of the entrance to the control chamber, and there should be no direct communication between the two chambers. Fig. 6 shows this arrangement as used at the Indian Orchard Plant at Springfield, Mass.

Digestion Tanks

It is well to repeat for emphasis a previously made statement that—

"ONE CAN CONTROL THE FORMATION OF EXPLOSION MIXTURES OF GAS AND AIR BY THE SIMPLE EXPEDIENT OF KEEPING THEM SEPARATED."

The simplest method of keeping air out of a digestion tank is by keeping the gas within the tank under the classification of a watertimes. In normal operation this condition is assured in the case of floating cover installations, since the unit floats upon the liquid in the tank and lowers when the liquid level is lowered by removal of sludge or liquor, thereby eliminating any space which must be filled up by air or liquid.

In the operation of fixed covered tanks not connected to a gas holder of ample capacity it is necessary to add liquid to the tank whenever sludge or liquor is withdrawn so that the liquid level in the digester is not lowered to a point where the gas is no longer under pressure. (1) (8) (9)

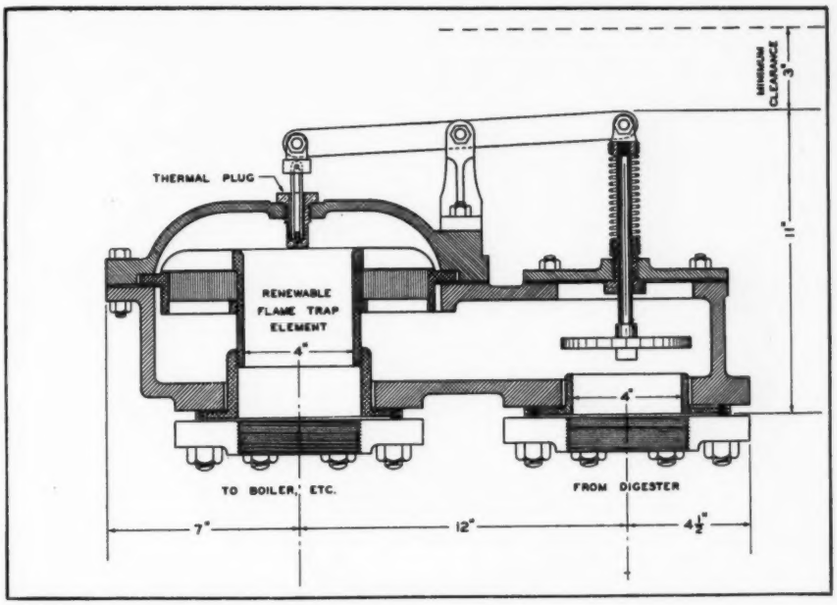


Fig. 8—Cross Section of Flame Trap of Proper Design

Pressure and vacuum reliefs on digestion tanks, installed to safeguard the structure, are described later. They should be provided with flame trap protection, but in any event the structure should be designed to be strong enough to resist failure under expected vacuum and pressure loads even if the unit fails to come into operation.

Gas Piping

As related to the prevention of explosions, the following general considerations should enter into the design of gas piping systems:

The gas piping system should be a closed system *without any portions which are not as strong as the pipe itself.*

Water seals of any type should not be allowed in the gas system due to the danger of gas leakage from the system if the water evaporates or is blown out. Also, the dangers of freezing must be considered. Float type of automatic drip traps come under a positive pressure at all seal trap, since the needle valve control has been known to be held open by sediment, thus allowing the water to drain from the unit and allowing gas to leak out.

Complete protection can be obtained from a manually operated type of drip trap as shown in Fig. 7. With this type of trap it is impossible for gas to leak out into the control room or building, since the inlet to the trap is automatically closed when the drain is opened.

Manometer gauges should be arranged so that they are vented to the outside atmosphere in case of breakage of the manometer tubes.

Explosion Proof Electrical Devices

Any motors or switches or other electrical devices located in gas control chamber should be of an explosion proof type designated as suitable for Class I, Group D, Hazardous Locations. Tools used about a digester should be of non-sparking nature.

Protective Devices

Flame Traps

Basically, any flame trap to be effective must serve to positively stop the passage of any flame or explosion. The flame trap should also be designed with a minimum of restriction to the normal flow of gas through the unit.

The simplest device to prevent the passage of flame is a wire gauze screen such as used in connection with the long used Davy miners' lamp. The value of such a flame resisting device placed in a gas line is questionable. This is true because the possibilities for dissipation of heat are limited and, on being subjected to a continued burning mixture, the gauze would quickly become hot enough to reignite the gas on the "protected" side of the gauze thus defeating the whole purpose of the unit. A metal gauze of this type

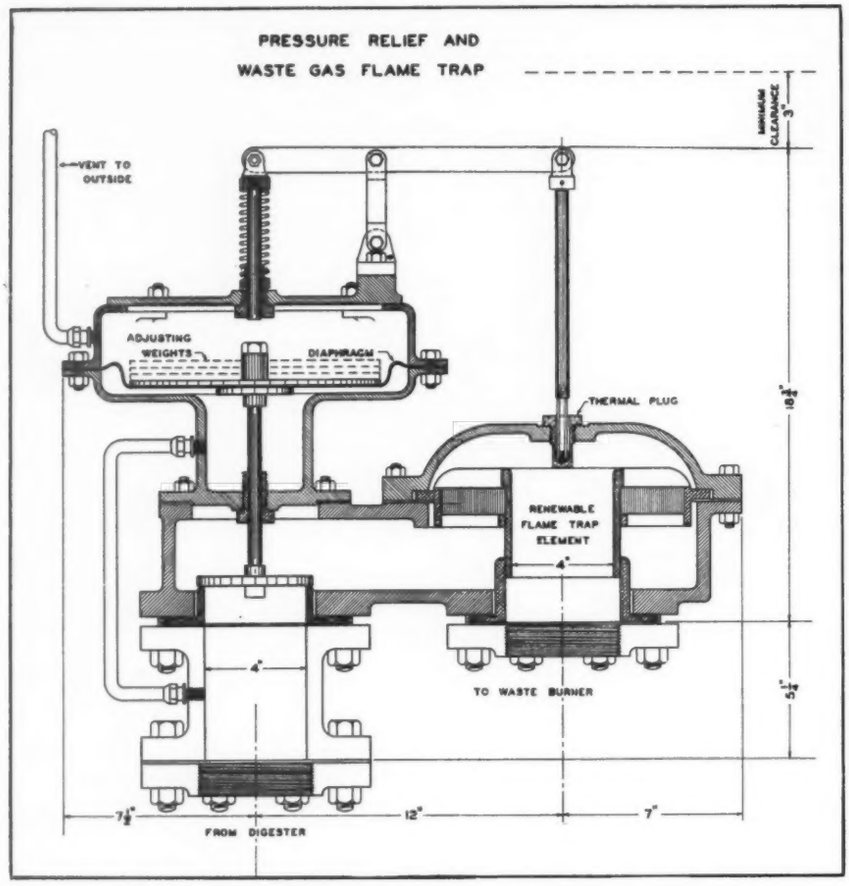


Fig. 9—Cross Section of Pressure Relief Waste Gas Flame Trap

would not be strong enough to resist the intensity of explosion pressures which might be developed, the explosion rupturing the gauze and causing failure of the unit.

Water seal flame traps also have been used with a false sense of security. Experiments with water seals in excess of 12 inches have resulted in failure to prevent the passage of flame with an explosive mixture of gas and air. It was observed that as the bubbles of gas passed through the water a series of small explosions occurred, successively igniting the bubbles of gas until reaching the supply pipe. Whatever safety a water seal type of trap may afford is naturally lost if the water seal is not maintained. The water seal type of flame trap presents no protection against explosion in the system, since the explosion pressure developed would blow out the sealing liquid and pass right through the unit.

A properly designed flame trap must provide flame protection against sustained burning within the unit, which may occur with a burnable mixture of gas and air. Likewise, against explosion flash-backs with excessive explosion pressure, which may occur with an explosive mixture of gas and air. The flame trap element should be of a material to resist the corrosive action of sewage gas and should be so arranged to provide a multitude of passages small enough to prevent the passage of flame and long enough to assure the dissipation of heat caused by the flame burning on the surface of the element. It has been found to be practically impossible to design a flame trap element which will indefinitely withstand the temperature of internal burning on the surface of the element. Therefore, to provide positive protection against continued burning mixtures it is necessary to provide means to automatically shut off the gas supply. A thermal element should be located near the burning zone of the flame trap to release and positively close off the gas supply. The passageways of the element should be vertical and unobstructed, assuring proper drainage of moisture, freedom from clogging due to impurities in the sewage gas, and passage of gas with a minimum of restriction. The flame trap element should be readily accessible for inspection and servicing. The entire flame trap unit should be designed to withstand explosion pressures which may be expected and, therefore, should be designed to be as strong as the piping system, which will normally withstand pressures up to 125 lbs per square inch. Fig. 8 shows an illustration of a properly designed flame trap.

Pressure Relief Units

The normal gas system should provide means to allow gas produced in excess of the rate of use to go automatically to waste. To maintain close control of the operating pressures within the gas system, the pressure relief should be of the diaphragm actuated type, providing for adjustment of relief pressure by adding or removing weights from the top of the diaphragm. The diaphragm housing chamber should be provided with a vent to outside atmosphere to preclude any possibility of gas escaping into the building in the event of a diaphragm failure. This pressure relief unit is generally found in a combination unit incorporating the flame trap, which provides protection against entrance of flame from the waste gas burner. (Fig. 9 shows details of a combination pressure relief waste gas flame trap unit.)

Each digestion tank should be provided with means for automatic release of gas at the digester. In case of a stoppage in the gas line, due to settlement and collection of moisture or other causes, proper pressure relief valve with suitable flame trap protection should be provided to allow the gas to escape without danger to the digester. The flame trap element for pressure relief, to allow gas to escape to atmosphere, may be designed to dissipate heat by providing a sufficient exposed and unrestricted surface of the flame trap element. In addition to the pressure relief on the digester, provision should be made for the relief of possible vacuum within the digester. Thus will be prevented structural failure in the event material is drawn out of the digestion tank to an extent which lowers the liquid below the safe operating level. Positive flame trap protection must also be provided, to assure that no flame may enter the digester when the unit is acting to relieve vacuum by allowing air to enter the tank.

Explosion Reliefs

Explosion reliefs have no place in the sewage gas utilization system. Any explosion relief must be so placed that it will release gas to outside atmosphere, and therefore, must in most cases, be located at some distance from the source of the

explosion. It is questionable that the operation of any relief so located would be effective. This statement is made because the speed of the explosion would undoubtedly carry the explosion pressures through the system before the relief valve could function. The source of explosion hazard can and should be eliminated by the proper location of adequate flame trap protective devices.

Gas Meters, Boilers

Gas meters should always be placed on the protected side of flame traps and should be designed to withstand the same pressures as other portions of the gas system. Gas fired boilers should be provided with adequate thermo-pilot controlled snap action shut-off valve and high temperature shut-off, both operating to control the main gas supply.

Location of Protective Devices

Properly designed flame traps should be provided as close as practical to each point of flame hazard. The closer the flame trap to the source of flame, the more effective it will be in limiting the intensity of the explosion. Tests, conducted by the Underwriters' Laboratories on flame traps for use with sewage gas, have indicated that the intensity of the explosion pressure increased as the size and length of the pipe between the source of flame and the flame trap increased. To limit the intensity of the explosion pressures, *flame traps should be located within 25 feet of the source of flame.* By isolating and providing adequate flame protection for each source of flame hazard, the gas system can be made safe. Protection must be provided for all units burning with open flame such as boilers, waste gas burners, pilots, incinerators, etc. And, internal combustion gas engines present a real hazard because of back firing. Any open end pipe such as a waste pipe from pressure relief, even though burning is not contemplated, should be provided with flame protection.

The operator at Lincoln, Nebraska, had an interesting experience in connection with the pressure relief valve on one of his digestion tanks. Lightning struck and ignited the gas being released through one of the pressure reliefs on one of the digesters. The gas burned on the surface of the flame trap element until the operator extinguished the flame. The flame trap element on this unit was adequate and prevented what otherwise might have proved serious consequences.

Design of the Gas System

(Will be dealt with in the second half of this article.—Ed.)

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G.E. Stages America's First Blackout Lighting Demonstration

• Blackout lighting, which facilitates the flow of auto and pedestrian traffic without being visible from the air, was demonstrated in this country for the first time at Lynn, Mass., before a crowd of 7,000, including prominent officials from electric utility companies, the army, and numerous city governments.

Arranged by General Electric engineers, the demonstration consisted of the lighting of specially designed blackout luminaries spaced 100 feet apart along an avenue. As the regular lights were turned off, airplanes droned overhead, adding a realistic note. With the blackout lights of about one candlepower each replacing the 4,000-candlepower street lights, it was possible to see persons or objects at a distance of about 25 feet. It takes about 15 to 20 minutes for the eyes to become adjusted to the low level of illumination.

The blackout luminaries are shaped like an admiral's hat and use a 2½-watt Argon (gaseous) lamp. The light they give off cannot be seen at more than a few hundred feet above the ground. Thus a city or other areas lighted with them would be invisible to bombers or observation planes which usually operate at about 20,000 feet to be outside the range of anti-aircraft fire.

The Argon lamp also gives off invisible light in the form of ultra-violet rays. It was demonstrated that sign posts, etc., covered with fluorescent paints glowed when activated by the rays.

British and American Blackout Luminaires

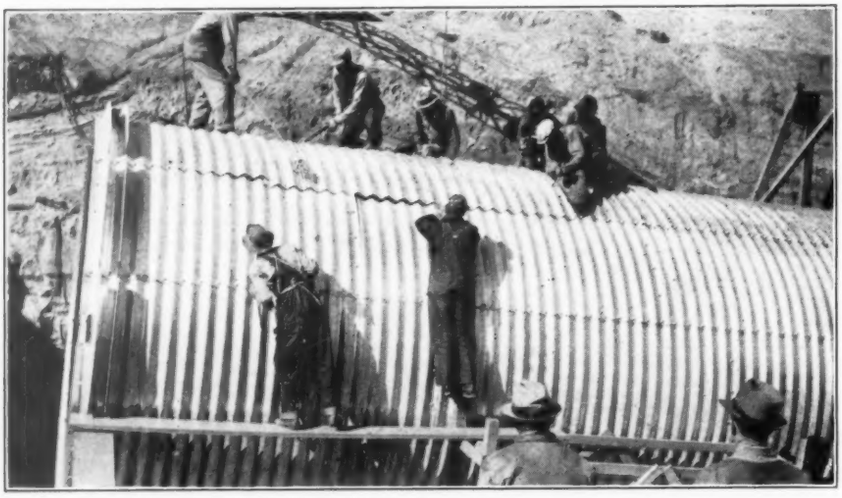
Second from left: W. H. Correale, Deputy Commissioner, Dept. of Water Supply, Gas and Electricity of N. Y. City, holds the smaller British unit, and W. D. Jennings, G-E lighting specialist, holds the American unit. Looking on are P. A. Porcella, Chief Supervising Inspector (left), and N. J. Kelly, Chief Engineer of Light and Power in N. Y. City's Dept. of Water Supply, Gas and Electricity.

CORRUGATED MULTI-PLATE CONSTRUCTION

Advantageously Employed in Building Large Siphon, Involving Arc-Weld Jointing as Novel Feature

By D. A. BUZZELL*
Chief Hydraulic Engineer
CENTRAL NEBRASKA POWER AND IRRIGATION DISTRICT

A SIPHON, located near Lexington, Neb., was designed to carry 1,500 cubic feet per second flow of the Phelps County irrigation canal under the bed of Plum Creek. The Phelps County canal is a part of the $30,000,000 Central Nebraska Irrigation and Power Project. Plum Creek, which empties into the Platte River one mile below the siphon location, is normally dry, although it has a drainage area of 300 square miles and at times discharges a large quantity of storm water. Ground water at the site is only 5 feet below the stream bed. Since the conduit would have to be 13 feet, 9 inches in diameter, with the top 6 feet below the stream bed, it was evident that most of the excavation would be below ground water.



Bolting Up Plates of 13′ 9″ Pipe Preparatory to Welding

Night Welding Scene on the 290 Foot Siphon
In all there was 12,000 ft. of ¼ in. fillet arc-welding of all joints, inside and out, at cost of 28.7 cents per foot.

Designs and estimates were made for a twin 8-foot by 8-foot concrete box and for a 13-foot 9-inch inside diameter corrugated multiplate steel pipe. The end transitions were designed in reinforced concrete and were alike for both plans. The steel pipe had cross sectional area of 148 square feet against an area of 128 square feet for the twin concrete boxes. The difference in the two areas is accounted for by the higher "N" value of the corrugated pipe walls and also the advantage of using a 165-inch diameter so that the plate sizes and details would be standard.

Welded Construction Without Precedent

Estimates indicated that there would be every reason to use the concrete box instead of the pipe. However, there was a great deal of uncertainty regarding some of the unit prices assumed, especially for wet excavation. No similar installation of a large corrugated pipe designed to withstand a fairly high hydraulic head, and completely field-welded, had ever before been undertaken and it was impossible to obtain reliable cost estimates for this work. It was known that the pipe itself, complete with all bolts and fittings, could be delivered to the site for about $42 per lineal foot. Due to unfamiliarity with multi-plate construction, the avialable contractors differed widely in their estimates of the cost to assemble the pipe. The welding, which was unprecedented, caused still more uncertainty. In spite of these objections and the larger indicated cost, it was decided to use the pipe siphon because of its greater safety and reliability.

*Engineer, Federal Power Commission, Washington, D. C.

The specifications called for ¼-inch continuous fillet welds along all seams, inside and outside. It was required that the welders be qualified and that the pipe be tested for leakage after completion. Three coats of asphalt paint, inside and outside, were also specified.

It was the intention of the owners' engineers that the entire pipe be completed on the original ground surface and then sunk by pumping the soil from beneath it. However, the contractor elected to first excavate and to build the pipe at its final grade, using a well-point system to keep the site dry. This latter method increased the excavation yardage enormously and it explains the apparent error in the quantity of common excavation on the list of bid prices.

Comparative Costs

This siphon was one item in a large general contract covering nearly half a million dollars' worth of canal structures. There were two other siphons—both of reinforced concrete construction. It is interesting to note that only one contractor bid higher for the pipe than he did for the box design. The low bidder for the siphon was $14,969 lower on the multi-plate than he was on the concrete box. Most significant of all is the fact that the six contractors averaged $6,728 low on the pipe as compared with the box. If this siphon had been let under a separate contract, the district would have saved as much as $14,969, or 33 per cent on this unit.

It should be pointed out here that this pipe was required to withstand both a considerable internal pressure due to the hydraulic head and also an irregular and unsymmetrical external pressure due to the saturated soil in which it was buried. The pipe might have been of standard steel penstock construction stiffened with angles or channels, or it might have been of reinforced concrete, either pre-cast or poured in place. However, both of these latter would have cost in the neighborhood of $150 per lineal foot exclusive of excavation and backfill.

Staging Used in Assembly of Multi-Plate Conduit.

The peculiar contribution of welding in this instance was to enable us to use multi-plate corrugated pipe which, due to its corrugations, could withstand the external pressure, but because of the bolted connections could not without welding stand the internal pressure.

It is because of the above that the writer feels that the welded construction in connection with corrugated pipe is something distinctly novel and that it can be depended upon to effect economies wherever like conditions may be encountered.

Summary

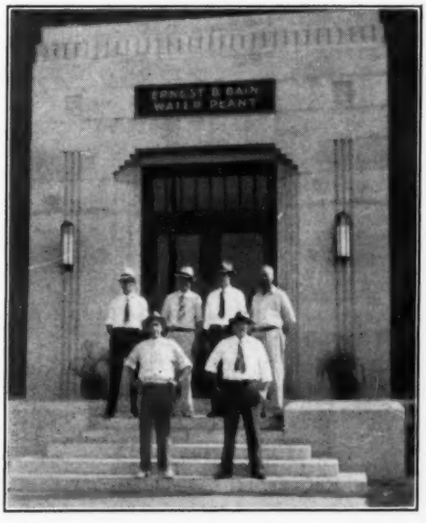
Diameter of conduit (inside)..
.....13 ft., 9 in.
Length of conduit.....290 ft.
Gauge of corrugated plate.....No. 1
Joints—bolted for erection—welded (¼ in. fillet) on inside and outside.
Finish—plates were hot-dip galvanized 2 ounces per square foot. Three field coats of bituminous paint applied inside and out after welding.
Total length welded joints.12,000 ft.
Subcontract for welding...$3,450.00
Cost per foot of weld.....28.7c
Cost per foot of conduit (13 ft. 9 in. diam.).....$11.94
Time required to weld (working three 8-hour shifts)....One week
Type of welding—..Arc-coated rods
Probable saving to owner through use of this design (average of 6 bids) $6,728

Note—The material and illustrations employed in this condensed statement have been taken from a study submitted to the James F. Lincoln Arc Welding Foundation by the author.

[The James F. Lincoln Foundation in its current Industrial Progress Program is offering 458 awards from $100 to $13,700 for winning reports of advances and improvements made by arc-welding in design, construction, and maintenance. We understand that the present program will be open for entries until June 1, 1942.—Ed.]

Some "City Dads" Go a Visiting

This photograph was made of the Mayor (H. C. Lonergan), with the entire Town Council and the Town Manager of Orange, Va., while on a recent tour of visits to modern filtration plants in the Southeast. Needless to say the "City Dads" of Orange are thinking of doing something about their filter plant.



The accompanying picture was taken on the front steps of the new Raleigh, N. C., plant which we understand whetted their appetites for a new plant for Orange considerably.

Concerning this trip, R. L. Blankenship, Town Manager, elatedly writes as follows:

"The marvel is that you could ever get an official body to go at all, and the miracle is that you could get the Mayor and all of the Council to accompany you on a trip concerning such a humble subject as the town water supply.

"I heartily recommend this stimulating dose to all of the water works men as you can mix a liberal amount of fun, pleasure and several types of water with profound effect. My council uses floc now as glibly as the rest of us amateurs. On the more serious side, I feel that this trip was richly profitable as we were able to see progressive development to the last word in the water purification."

Good work "R.L.B.," and congraulations! We too recommend this "stimulating dose" to the water works operators.—Ed.

An Unjustifiable Obligation

IT IS a rare occasion when John Murdoch appears before associations, other than his Pennsylvania Water Works Association, of which he has long been the energizing president, to read a paper. It is a rare treat to hear this water works authority, from the management and policy side of the house, discuss any topic which he knows as thoroughly as he does that pertaining to the legal and the moral responsibility of the water works operator.

Attorney Murdoch's most recent paper—that presented early this month before the Pennsylvania Water Operators Association, a "first cousin" to his own association of privately operated water company officials, is reproduced in full in this issue. It discusses "The Legal Responsibilities of the Water Works Operator," and, therefore, deserves wide reading by municipal as well as company operators.

His analysis of the ever troublesome cross-connection problem and legal responsibility of the water utility management therewith, should pollution enter the supply system through such state sanctioned interconnections, is particularly deserving of close reading and attention. It is in the very closing paragraphs of his paper that Mr. Murdoch brings out into the light the question of how far the water utility management should go in the direction of assuming certain obligations which have recently been hinted by some public health authorities should be assumed; and, apparently attempts have been made outright by one or more such authorities to place on the doorstep of the water works management (private and public) this added obligation. Such obligation, which Mr. Murdoch classes as "unjustifiable," is that of assuming responsibility for all cross-connections on the system, and including those which are broadly defined as plumbing or back-syphonage hazards. That is to say the water utility management is expected to assume the responsibility for whatever may happen to the water within the customer's premises, entailing the policing of premises and maintainence of a plumbing inspection service continuously.

In warning operators against the assumption of such an unjustifiable and hazardous obligation, Mr. Murdoch points out that—"The water utility probably has no legal right to make the inspection and it certainly has neither the money nor the ability required to make the original exhaustive and complete surveys, thereafter, periodic inspection at frequent intervals, which alone could give real protection. By once assuming such an unjust obligation the water works operator may possibly find one day that he is being held negligent in failing to do thoroughly that which he had unwisely undertaken to do. Good water works practice certainly indicates that it is better to do well that which water works operators have the legal obligation to do—police their own systems and facilities —than to raise a false sense of security by half doing that which they have no legal obligation to do."

In the end Mr. Murdoch states: **"Such an obligation ought not to be assumed."** In this we concur.

To this writer's thinking if cross connections are authorized or permitted by state authorities, in full recognition of whatever degree of potential hazard may exist therewith, the real responsibility should lie with the individual or company benefiting and the approving agency. Certainly the policing of the many properties served by the water utility is beyond reasonableness of demand. Is this not a governmental function in the final analysis?

A "Marvel and Miracle"

ON ANOTHER page of this issue is printed a brief story concerning a tour of visits by a small town's mayor and the entire council over the Labor Day week-end to modern water purification plants. To us this story had all the ear-marks of NEWS.

The account was made possible as the result of a letter from R. L. Blankenship, town manager of Orange, Va., which told of the tour and how interested his "bosses" had become in such things as flocculators, stability indicators, and how quickly they had come to use technical terms in their discussions and questions. Mr. Blankenship, feeling a very understandable degree of elation over having been successful in engineering the tour, and in finding the "class" almost as adsorptive as the floc particles in Durham's new flocculators, had the following to say:

> "The *marvel* is that you could ever get an official body to go at all. And the *miracle* is that you could get the mayor and entire town council to accompany you on a trip concerning such an humble subject as the town water supply."

Yes, and further in this direction it is to be noted that this group put their Labor Day holidays to such use. It is apparent to this writer that Manager Blankenship did a first rate "selling" job on his bosses to get them sufficiently interested to go along en-masse. It is also apparent that Mr. Blankenship believes in the age-old axiom to the effect that "to sell 'em you've got to show 'em."

Further in Mr. Blankenship's letter he states:

"And I can heartily recommend this stimulating dose to all water works managers."

It gives us a large measure of pleasure to be able to join Mr. Blankenship in his gratification and show of elation over the net results of the junket trip of his planning.

It has frequently been our thought that there would be many more modern and efficiently operated water purification and sewage treatment plants in the small towns if it were only possible to get the Town Fathers to lunch together some rainy day and then take the group around the corner to a sample showroom for the purpose of showing them various types of plants, as the traveling salesman displays his wares for the benefit of the merchants he sells in such communities. If this were possible there would be far fewer small plants operated on the bailing-wire principle.

Manager Blankenship has really got something here in his successful efforts in the direction of "showing 'em to sell 'em" and we wish to join with him in his recommendation of this stimulating dose to other water works managers, and equally so to sewage works managers.

In this direction there is one more "thought of the day" which may be a shoe that pinches some readers —but, it is this writer's firm conviction that if there is more selling and less griping by water works operators there will be many more show plants in this country and fewer of the "bailing-wire" variety to contend with.

Hats off to you, Mr. Blankenship—and, also, to Orange's mayor and council.

L. H. Enslow

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2. Sewerage Section —112 pages
3. Engineering and Operating Data — 31 pages

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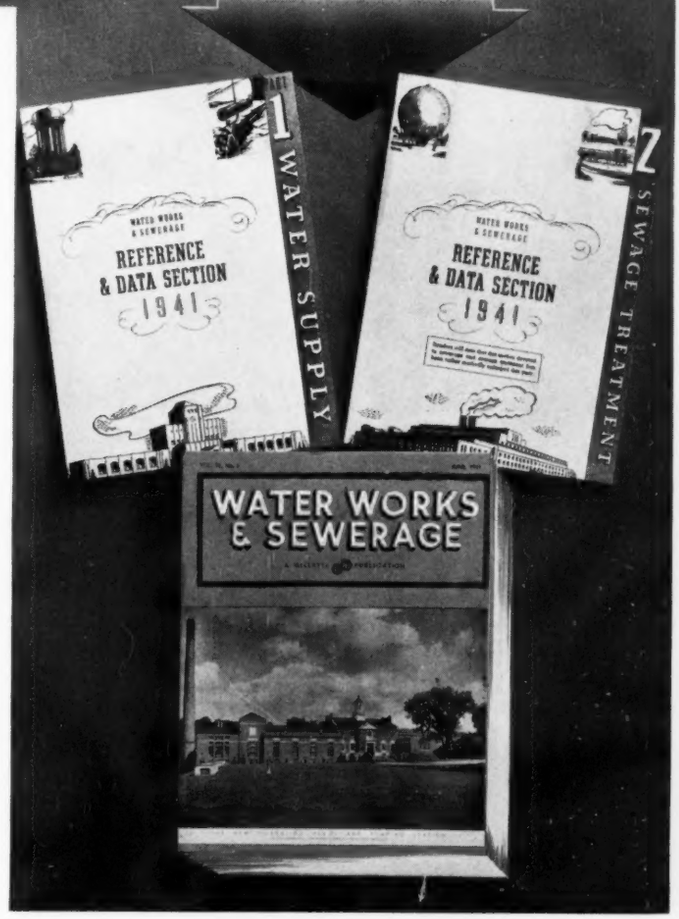

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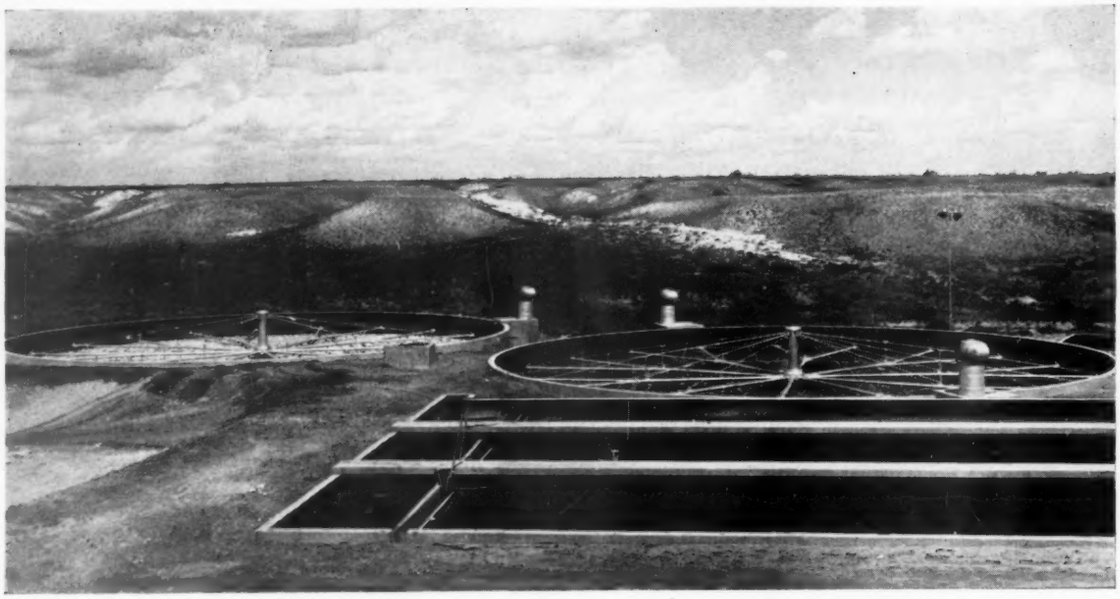

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determine necessary extensions and replacements to meet present needs and future requirements over a twenty-five year period. See Bulletin No. 18.

Send for Bulletins Nos. 17 and 18—Full information on request

MEETINGS SCHEDULED

Sept. 18-19—SANTE FE, NEW MEXICO (LaFonda Hotel)
Rocky Mountain Section A.W.W.A. Secretary, E. V. Howe, Sanitary Engineer, State Board of Health, Denver, Colo.

Sept. 18-19—MANSFIELD, OHIO (Mansfield-Leland Hotel)
Ohio Conference of Sewage Treatment. Secretary, B. M. McDill, Department of Health, Columbus, Ohio.

Sept. 19-20—PROVIDENCE, R. I. (Hotel Biltmore).
New England Sewage Works Association. (Annual Fall Meeting.) Sec'y-Treas., LeRoy W. VanKleeck, State Dept. of Health, Hartford, Conn.

Sept. 23-26—BOSTON, MASS. (Hotel Statler)
New England Water Works Association (Annual Convention). Secretary, Frank J. Gifford, 613 Statler Building, Boston, Mass.

Sept. 24-26—GRAND RAPIDS, MICH. (Hotel Pantlind)
Michigan Section A.W.W.A. Secretary, Maurice N. Gerardy, Department of Water Supply, Detroit, Michigan.

Sept. 26—CHESTER, PA.
Pennsylvania Water Works Operators' Association. (Sectional Meeting.) Secretary, I. M. Glace, 22 South 22nd St., Harrisburg, Pa.

Oct. 6-8—RACINE, WIS. (Hotel Racine)
Wisconsin Section A.W.W.A. Sec'y-Treas., Leon A. Smith, City Hall, Madison, Wis.

Oct. 9-11—MINNEAPOLIS, MINN. (Nicollet Hotel)
Minnesota Section A.W.W.A. Secretary, R. M. Finch, Wallace & Tiernan Co., Inc., 416 Flour Exchange, Minneapolis, Minn.

Oct. 9-11—NEW YORK, N. Y. (Hotel Pennsylvania)
Federation of Sewage Works Associations. Executive Secretary, W. H. Wisely, P. O. Box 18, Urbana, Ill.

Oct. 12-14—SACRAMENTO, CALIF.
The California Sewage Works Association. Secretary-Treasurer, Wm. T. Ingram, P. O. Box 111, Stockton, California.

Oct. 13-17—ATLANTIC CITY, N. J.
Conference of State Sanitary Engineers. Secretary, H. N. Old, U. S. Public Health Service, Washington, D. C.

Oct. 13-16—FORT WORTH, TEXAS (Texas Hotel)
Southwest Section A.W.W.A. Secretary, L. A. Quigley, Supt. City Water Works, Fort Worth, Texas.

Oct. 13-15—JAMESTOWN, N. D.
North Dakota Water & Sewage Works Conference. (13th Annual Meeting.) Sec'y-Treas., H. G. Hanson, State Department of Health, Bismarck, N. D.

Oct. 14-17—ATLANTIC CITY, N. J. (Convention Hall)
American Public Health Association (70th Annual Meeting). Executive-Secretary, Reginald M. Atwater, M.D., American Public Health Ass'n., 1790 Broadway, New York, N. Y.

Oct. 15-17—ATLANTIC CITY, N. J. (Haddon Hall)
Pennsylvania Water Works Association. Secretary, Dr. F. Herbert Snow, 710 Telegraph Bldg., Harrisburg, Pa.

(Continued on next page)

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MEETINGS SCHEDULED

Oct. 16-18—ATLANTIC CITY, N. J.
New Jersey Section A.W.W.A. Secretary, C. B. Tygert, P. O. Box 187, Newark, N. J.

Oct. 16-17—KITCHENER, ONT. (Walper House)
The Canadian Institute on Sewage and Sanitation. Sec'y-Treas., Dr. A. E. Berry, Dept. of Health, Toronto, Ont.

Oct. 20-22—JAMESTOWN, N. D.
North Dakota Water & Sewage Works Conference. Secretary, Wm. J. Nordley, Edgeley, N. D.

Oct. 20-22—CEDAR RAPIDS, IOWA (Montrose Hotel)
Missouri Valley Section A.W.W.A. Secretary, Earl L. Waterman, Prof. of Sanitary Engineering, Univ. of Iowa, Iowa City, Ia.

Oct. 22-25—FRESNO, CALIF. (Hotel Fresno)
California Section A.W.W.A. Sec'y-Treas., G. E. Arnold, San Francisco Water Department, Millbrae, Calif.

Oct. 22-25—ATLANTA, GA. (Georgia Tech)
Annual Water & Sewage School of the Georgia Water & Sewage Association. Director of School, Prof. H. A. Wycoff, Georgia Tech. Ass'n Sec'y, Paul Weir, 1210 Hemphill Ave., Atlanta, Ga.

Oct. — —FORT WAYNE, IND.
Central States Sewage Works Association. Secretary, E. J. Beatty, State Board of Health, Madison, Wisc.

Oct. 23-24—COLUMBUS, OHIO (Hotel Fort Hayes).
Ohio Conference on Water Purification. (21st Annual Meeting.) Secretary, T. R. Lathrop, State Department of Health, Columbus, O.

*Oct. 26-29—NEW ORLEANS, LA. (Roosevelt Hotel)
American Public Works Association. Executive Director, Norman Hebden, 1313 East 60th St., Chicago, Ill.

Oct. 27-29—NASHVILLE, TENN. (Andrew Jackson Hotel)
Kentucky-Tennessee Section A.W.W.A. Secretary H. D. Schmidt, Director Div. of Sanitary Engineering, Department of Health, Nashville, Tenn.

Oct. 30-Nov. 1—MORGANTOWN, W. VA. (Hotel Morgan)
West Virginia Section A.W.W.A. Secretary, J. B. Harrington, Assoc. Engr., State Department of Health, Charleston, W. Va.

Oct. 30-31—ROANOKE, VA. (Hotel Roanoke)
Virginia Section A.W.W.A. Secretary, Norman Phillips, Ass't San. Engr., State Dept. of Health, 119 State Office Bldg., Richmond, Va.

Nov. 3-4—PITTSBURGH, PA. (Wm. Penn Hotel)
Engineering Society of Western Pennsylvania (Water Conference). Chairman, H. M. Olson, 171 Longue Vue Drive, Mt. Lebanon, Pittsburgh, Pa.

Nov. 3-5—HIGH POINT, N. C. (Sheraton Hotel)
North Carolina Section A.W.W.A. and
North Carolina Sewage Works Association. Secretary, R. S. Phillips, Box 1170, Durham, N. C.

Nov. 6-7—BALTIMORE, MD.
Four States Section A.W.W.A. Secretary, Lloyd Nelson, U. S. Pipe and Foundry, Broad and Chestnut Streets, Philadelphia, Pa.

Nov. 13-15—DAYTONA BEACH, FLA. (Osceola Hotel).
Florida Section A.W.W.A. Secretary, Professor A. P. Black, Department of Chemistry, University of Florida, Gainesville, Fla.

*(Change in dates from previous listing.)

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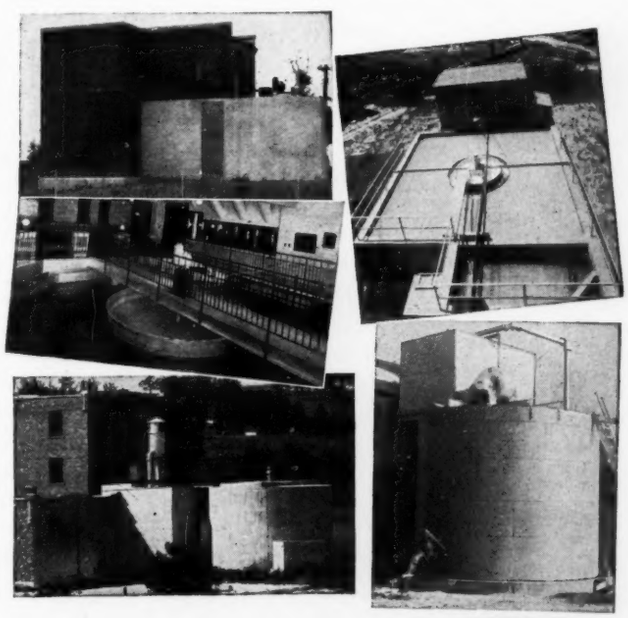

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LITERATURE AND CATALOGS

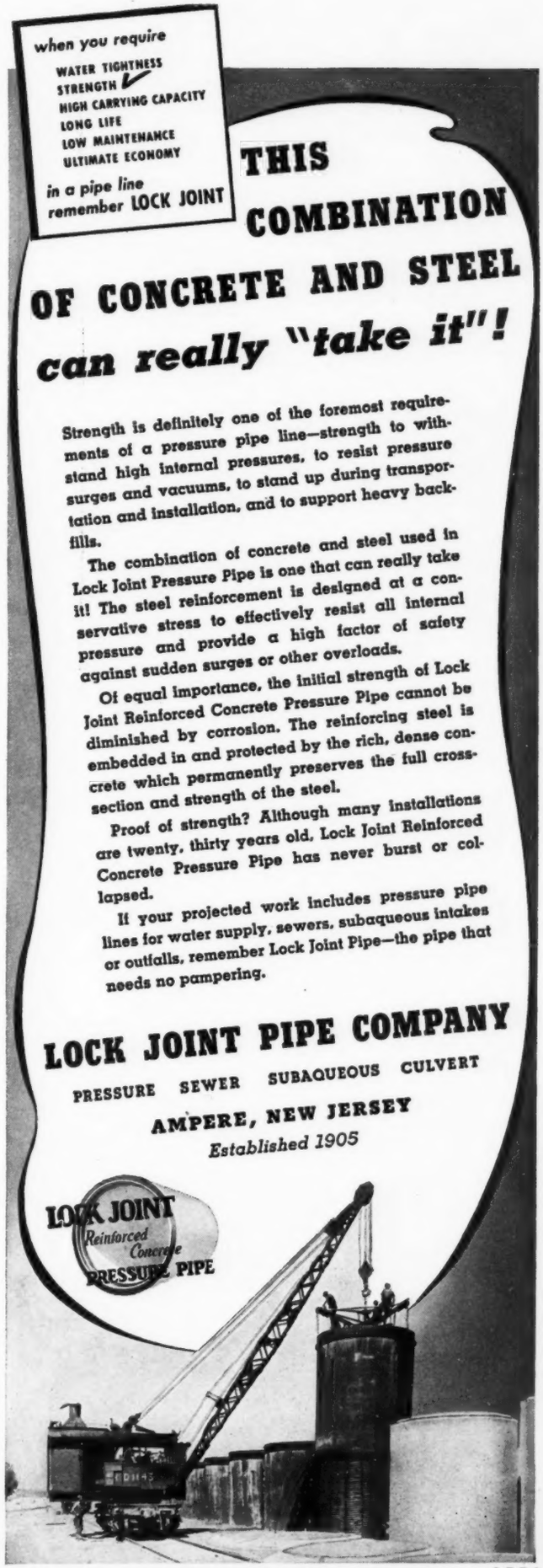
"Aloxite" Filter Underdrain Systems are the subject of the recently revised Engineering Bulletin No. 2 of The Carborundum Co., which when originally issued made filter-bottom history. The now revised and up-to-date bulletin describes the porous plate filter bottom developed by The Carborundum Co. in the early 1930s, making use of a special grade of porous plate of coarse grained "Aloxite" (oxide of aluminum) as the supporting floor for the sand bed. The purpose behind this novel bottom is that of securing a corrosion proof bottom and particularly the elimination of the trouble-breeding gravel layers for rapid sand filters. Amongst porous plate bottom advantages listed and discussed are (1) Uniformity of wash; (2) Low construction and operation costs; (3) Air and water wash through the same distribution facilities, applied separately or in combination; (4) Eliminaton of gravel bed and lowering of filter box depth. Two types (design) of plates and methods of installation are described and illustrated in detail for the enlightenment of designers and builders of filters. The adaptation of the porous plate false bottoms in pressure type filters is also covered. Methods of operation and records of head loss history, with "Aloxite" plates in service, are given. At the last are presented Standard Specifications for Porous Underdrain Plates and Their Installation. For a copy of Engineering Bulletin No. 2 (Revised 1941) write The Carborundum Co. (Sanitary Engineering Div.), Niagara Falls, N. Y.

Chlorine*—When we first studied chemistry the atom was a dull and drab indivisible bit of matter. The chemist of today pictures atoms as something entirely different—to wit; the colorful pictorial conception of the chlorine atom of 1941, which adorns the cover of Pennsylvania Salt Co.'s new publication "Chlorine." For the cover of this 48 page handbook, the artist has done a rather remarkable job of picturing the chlorine atom with its nucleus (sun) and its many phantom-like electrons (planets) with their individual orbits of high speed travel. We are told that the magnification represented is approximately two-and-one-half thousand million times.

This 6th edition of Penn. Salt's bulletin "Chlorine" is, in truth, a handbook on the properties, packages, safe handling and uses of chlorine. Beginning with "Properties of Chlorine," the next section is devoted to "Liquid Chlorine Containers and Valves"—their design features, proper methods of servicing and handling, and equipment therefor. There follows a useful chapter on "Piping and Fixtures." "Uses of Chlorine" tells in condensed paragraphs its several uses in water and sewage treatment, for slime prevention and control, and in swimming pools. The chapter "Handling Chlorine Leaks" contains information which should be studied by every chlorine user. The same can be said for "What to do in Case of Accidents." Two articles in the appendix describe Penn. Salt's method of producing extra quality liquid chlorine, free from gums and other deposit forming impurities, consisting of a novel scheme of "bathing" the freshly produced chlorine gas *before* liquefaction. All chlorine going to chlorinator users is so produced.

Those who have found previous editions of "Chlorine" useful will want the new 6th edition—and others should. It may be had without cost by writing Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.

*Compiled and Edited by L. L. Hedgepeth, Mgr., Technical Service Dept.


when you require
WATER TIGHTNESS
STRENGTH
HIGH CARRYING CAPACITY
LONG LIFE
LOW MAINTENANCE
ULTIMATE ECONOMY
in a pipe line
remember LOCK JOINT
THIS COMBINATION
OF CONCRETE AND STEEL
can really "take it"!
Strength is definitely one of the foremost requirements of a pressure pipe line—strength to withstand high internal pressures, to resist pressure surges and vacuums, to stand up during transportation and installation, and to support heavy backfills.
The combination of concrete and steel used in Lock Joint Pressure Pipe is one that can really take it! The steel reinforcement is designed at a conservative stress to effectively resist all internal pressure and provide a high factor of safety against sudden surges or other overloads.
Of equal importance, the initial strength of Lock Joint Reinforced Concrete Pressure Pipe cannot be diminished by corrosion. The reinforcing steel is embedded in and protected by the rich, dense concrete which permanently preserves the full cross-section and strength of the steel.
Proof of strength? Although many installations are twenty, thirty years old, Lock Joint Reinforced Concrete Pressure Pipe has never burst or collapsed.
If your projected work includes pressure pipe lines for water supply, sewers, subaqueous intakes or outfalls, remember Lock Joint Pipe—the pipe that needs no pampering.
LOCK JOINT PIPE COMPANY
PRESSURE SEWER SUBAQUEOUS CULVERT
AMPERE, NEW JERSEY
Established 1905
LOCK JOINT
Reinforced Concrete
PRESSURE PIPE
9-LJ-3

Don't Let Corrosion Get Your Pipe!

COAT IT!

For more than 25 years, engineers and operators have recognized the fact that corrosive soil action quickly breaks down most types of ferrous pipes. It takes a tough, durable coating to assure long life and low-cost service.

WRAP IT!

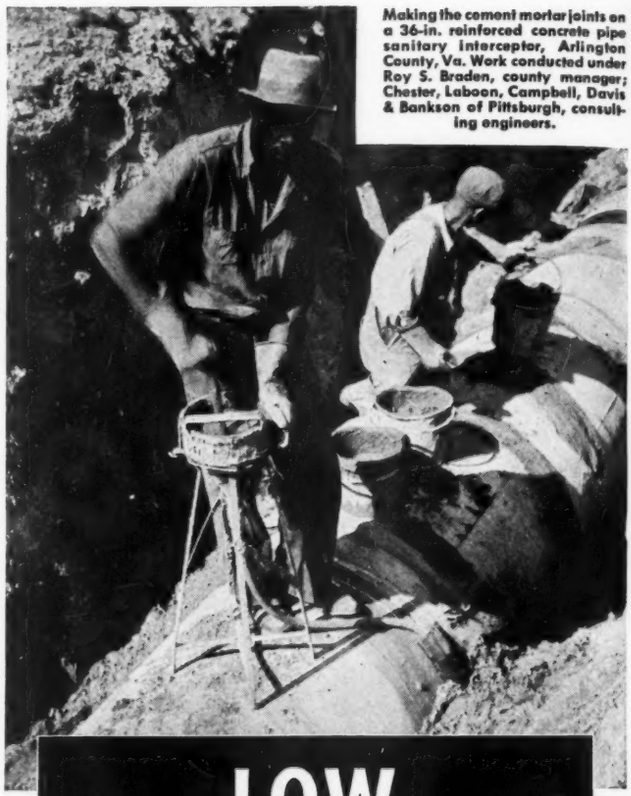
Soil stress can cause serious damage even to a rugged coating. Unless the coating is properly reinforced or shielded with a lasting protective wrapping, maintenance and replacement charges may easily become expensive problems.

Use the BEST wrapping ... ASBESTOS!

Authorities agree that only *asbestos* pipe-line felts give positive assurance of long life and low upkeep. Be sure you get *full* protection by using J-M Felts. They're made of inorganic, non-tubular asbestos fibers . . . cannot support capillary action. Their unusual strength and durability prevent distortion or abrasion of the coating. And they effectively resist all forms of corrosion . . . keep maintenance at permanently low figures.

FULL DETAILS will show you how J-M Asbestos Felts add years of life to pipe lines under any service conditions. Ask for Brochure DS-375. Johns-Manville, 22 East 40th Street, New York, N. Y.

Johns-Manville
ASBESTOS PIPE-LINE FELTS



Making the cement mortar joints on a 36-in. reinforced concrete pipe sanitary interceptor, Arlington County, Va. Work conducted under Roy S. Braden, county manager; Chester, Laboon, Campbell, Davis & Bankson of Pittsburgh, consulting engineers.

LOW INFILTRATION

. . . a feature of this 130-mile sewerage system of CONCRETE PIPE

ARLINGTON COUNTY, VIRGINIA, secured a PWA loan and grant to build a $2,500,000 sewerage system. Included in the project were over 100 miles of concrete pipe lateral sewers and 30 miles of concrete pipe interceptors ranging in diameter from 10 in. to 42 in.

Typical sections of pipe lines, including manholes, were given rigid infiltration tests. As a result of using concrete pipe, with proper foundations in yielding soils, and with carefully made portland cement mortar joints . . . infiltration tested as low as 600 and up to 6,000 gallons, averaging only 2,500 gallons per mile per day under difficult conditions.

Whether sewers are a few inches or many feet in diameter, remember that concrete pipe minimizes infiltration and leakage . . . is strong and durable . . . resists corrosion . . . is moderate in first cost . . . and serves with little maintenance.

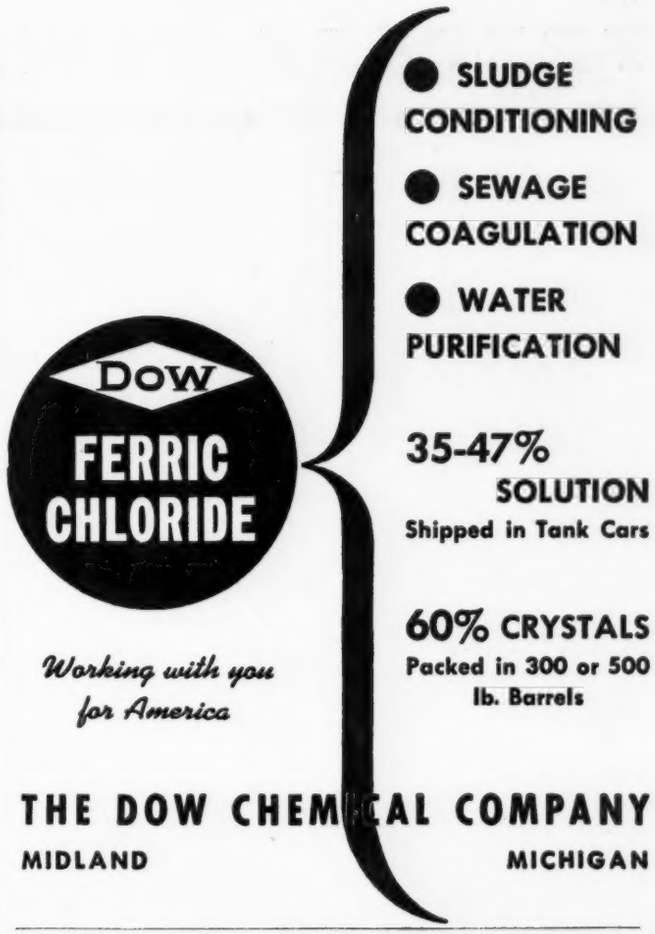
PORTLAND CEMENT ASSOCIATION
Dept. A9-29, 33 W. Grand Ave., Chicago, Ill.

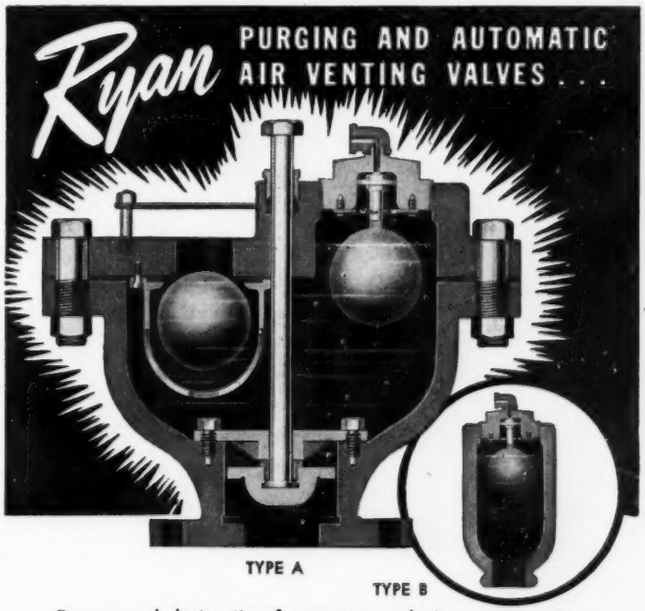
A national organization to improve and extend the uses of concrete

Sewage Pumps, by Gardner-Denver—are presented in a new bulletin from Gardner-Denver Co., of Quincy, Ill. A thorough description accompanied by dimensional drawings is given for the Type J. horizontal open impeller sewage and trash pumps and the Type K vertical unit of the same general design and performance. The bulletin points out that these pumps are in actual use pumping coal and water (50 per cent coal in sizes to 2 inch) and in pumping vegetable refuse from industrial plants and steel shavings at another. Detailed specifications are given for these Type J and K pumps and a variety of drive shafts for the vertical type. Automatic Duplex Sump Pumps are also covered and typical installation pictures complete the bulletin. For a copy write Gardner-Denver Co., Quincy, Ill.

The Lubriplate Film is the subject of a new bulletin from Fisk Brothers Refining Co., of Newark, N. J., which describes "Lubriplate" lubricants for a variety of lubricating jobs at water and sewage plants. Possibly, and probably, new to most readers of this magazine, "Lubriplate" lubricants have been used for eight years in at least one sewage plant—that of Westchester County at Mamaroneck, N. Y.—with satisfaction and highly favorable comments of the plant superintendent. The bulletin goes on to recite other case histories in which "Lubriplate" lubricants have been employed in the water and sewage fields. Amongst other claims is the particularly interesting statement that "Lubriplate" actually "conditions the surfaces of bearings, gears, chains, ec.," and the second point emphasized is the fact that "Lubriplate" does not wear out or break down, as do many other lubricants. It also serves as protection against corrosion. Listed are typical applications of the various grades of "Lubriplate," with designating numbers shown for the recommended types for various machines and machine parts. For further information concerning "Lubriplate," classed as a "new principle" lubricant, write Fiske Brothers Refining Co., Newark, N. J.

Bitumastic for Water and Sewage Works is the story told in Wailes Dove-Hermiston's "Bitumastic Bulletin," No. 9, for September, 1941. The first article tells of the use of Bitumastic No. 70-B Enamel as a protective coating for steel constructed Spauling Precipitators fabricated for The Permutit Co., as the purveyors. The second story is that of a long period demonstration of the protective merits of various Bitumastic coatings applied to steel and concrete, partially and wholly submerged in a corrosive sewage —one containing sea water, productive of chloride and sulphide attack on structural members and equipment. The pictures of the exposed test specimens largely tell their own story and give prospective users of Bitumastic No. 50 (cold brushed) and No. 70-B Enamel (hot brushed or dipped) something in the way of proof of the validity of claims and recommendations of the manufacturer. The bulletin also directs attention to the scarcity of zinc for galvanized pipes and other items, and suggests that Bitumastic No. 50 be considered as a reliable zinc substitute at a lesser cost than galvanizing. For Bulletin No. 9, write Wailes Dove-Hermiston Corpn., Westfield, N. J.

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PURGING AND AUTOMATIC AIR VENTING VALVES . . .
TYPE A
TYPE B
Danger and destruction from entrapped air or gas in pipelines and tanks are promptly eliminated by Ryan Purging and Automatic Venting Valves. Permitting rapid filling of either pipelines or storage tanks without opening and closing hand or motorized valves, Ryan Automatic Valves do away with the danger of overflow and its hazards to life and property. Practically no attention nor maintenance required. Fully illustrated Bulletin No. 100 on request.
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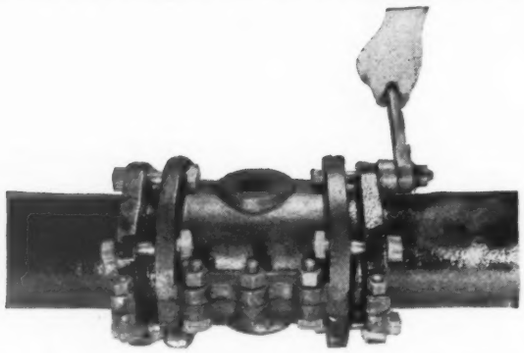
FRED J. RYAN COMPANY
5244 GERMANTOWN AVE. PHILA., PA.

PREPARE NOW
for Winter Emergencies



STOCK UP WITH IMPROVED DOUBLEX SIMPLEX SPLIT SLEEVES

When Jack Frost starts playing around, you will need some of these improved sleeves for quick, economical, effective repair of broken mains. Keep several of different sizes on hand and avoid costly delays during cold weather. On the market for 12 years and many thousands in use. Order now!

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Direct Subway Entrance to all Points of Interest

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OUR CHOICEST ROOMS From $3

1400 ROOMS each with Bath, Servidor, and Radio.

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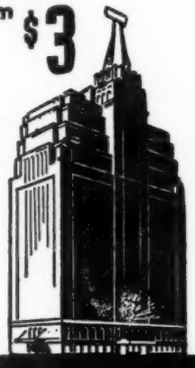

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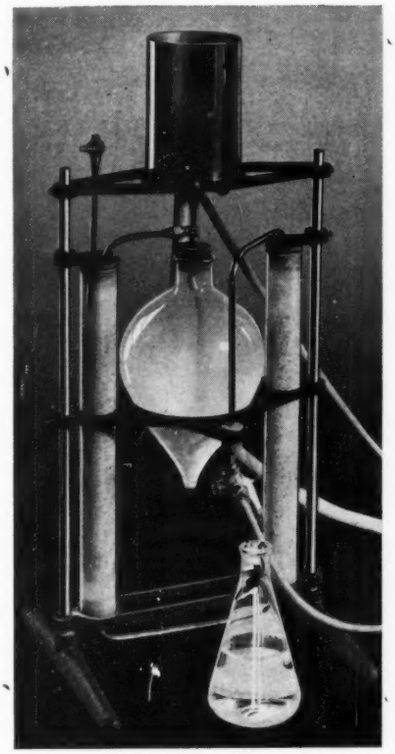
EQUIPMENT NEWS

Improved Stability Indicator



● Phipps & Bird, Inc., of Richmond, Va., announces a new and vastly improved model of the Enslow Stability Indicator.

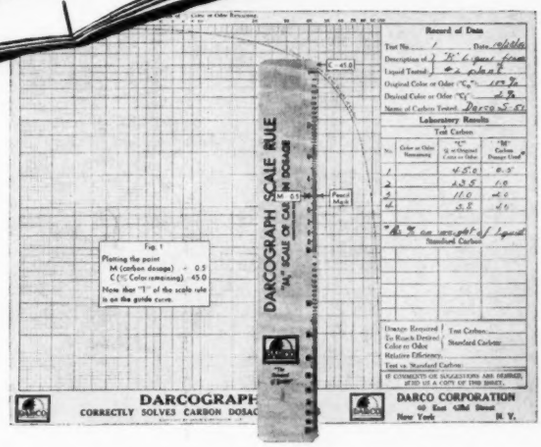
This apparatus, conceived by Linn H. Enslow, Editor of this magazine, provides a continuous corrosivity or stability index with the fewest possible number of operations and minimum time requirement. It has been completely redesigned to embody several features which were suggested and developed by practical waterworks men from tests made under actual plant operating conditions.

Two outstanding improvements which have greatly increased the effectiveness of the device are, a constant head tank and a specially designed calcium carbonate contact chamber, which holds a charge of precepitated chalk.

Water flows through the indicator continuously. It enters the constant head tank without turbulence, thence flows through a tube which extends downward to the bottom of the calcium carbonate contact chamber. The shape of this vessel produces a tapered velocity of upward flow to float the chalk "blanket," thus affording effective distribution and intimate contact between water and chalk without danger of sweeping out the light chalk. In this respect it resembles the well-known conical shaped Spaulding precipatator.

(Continued next page)

Get the Facts About Activated Carbon!



● The Darcograph—one of the 3 performance tests evolved by Darco for waterworks men.

Check PERFORMANCE for Yourself!

Forget claims — get the facts on activated carbon! Use the Threshold Odor Test, the Carbon Feed Chart, and the Darcograph to check carbon performance right in your own plant!

See for yourself that Hydrodarco — the activated carbon specially made for water treatment—brings maximum palatability control per dollar.

Send for a Darcograph set, and for information on how to conduct the Threshold Odor Test. Write today!

HYDRODARCO

The new-style bag is sealed and taped with Latex tape, to prevent sifting.

Hydrodarco Reg. U. S. Pat. Off.

DARCO

DARCO CORPORATION

60 East 42nd Street, New York, N. Y.

DISTRIBUTING POINTS: New York • Buffalo • Cincinnati • Chicago • St. Louis • Kansas City • San Francisco • Los Angeles • Marshall, Texas

IRONCRETE
BOX *and* FORM

For water meter settings in service lines from one to two feet in depth, the IRONCRETE BOX provides a durable, sightly, inexpensive and most satisfactory housing. We provide tops having lids fitted with the Ford Worm Lock, on which you can cast a concrete barrel of desired length by means of a convenient form.

IRONCRETE Forms are simple and easy to use. With a supply of tops and one of these forms you can make up boxes as you need them. You save on freight, storage space and in the use of spare-time labor. You can be really proud of the IRONCRETE Boxes you can make.

WRITE FOR OUR
CATALOG.

FORD
METER BOX
CO.,
WABASH, IND.

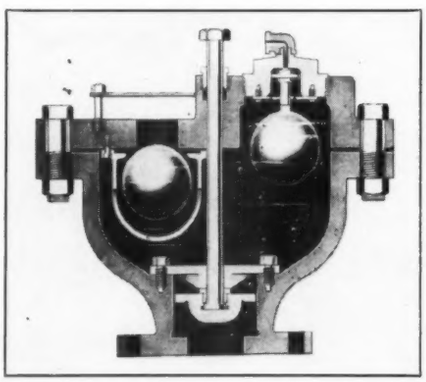
As the water passes from the top of this chamber it flows downward through the primary trap tube containing No. 2 calcite sand. Thence upward through the secondary tube which is filled with No. 1450 grade calcite sand and serves as a trap and decolloidizing unit. The completely stabilized effluent from this secondary tube flows to a 2-way cock which permits it to be run into a sampling flask or to waste in any quantity from a mere dribble to a constant stream.

Other new features of the improved Enslow Stability Indicator include an air-bleeder on the primary trap tube to preclude pressure build-up and possible cracking of the tubes. Adjustable metal clamps, which hold the rubber stoppers securely in these tubes, represent another improvement of practical merit. The constant head tank and tubing are of highly polished nickel. A metal frame finished with baked, corrosion-resistant enamel furnishes a sturdy and compact mounting for the apparatus.

Markedly simplifying and ensuring accuracy of the well-known but laborious and time-consuming marble stability test, this new piece of laboratory equipment combines attractiveness and practicability to a degree which makes it a valuable aid and time-saver for indicating and controlling anti-corrosion treatment, or the production of non-encrusting water in water softening practice with a minimum number of laboratory operations and time required. Nothing more than ordinary alkalinity titrations are involved in its use. No complicated calculations are required. Thus it comprises a highly useful treatment control "tool" for the practical operator as well as the trained chemist.

For further details and descriptive literature, write Phipps & Bird, Inc., Laboratory Supplies, Richmond, Va.

Ryan Air-Release and Vacuum Relief Valves



• The Fred J. Ryan Co. of Philadelphia, offer an interesting design of Automatic Air-Release, Vacuum Relief and Purging Valve for pipe lines and tanks.

The principal novel features of the Ryan valves, already long used in the industrial and pipe line fields, include

The
FORD
Copperhorn

Here's your modern meter setting for modern basements. All brass and copper, it is attractive in appearance, lasts a lifetime, minimizes pressure losses. The COPPERHORN is easy to install, putting the meter at the desired height, in the proper position, requiring no meter couplings or pipe fittings.

When you remove the meter you leave the customer's pipe physically connected and supported, — electrically bonded. Here's trouble insurance in meter changing.

Hundreds of water works have standardized on the COPPERHORN. Hundreds of thousands are in service. Learn more about this modern meter mounting.

Ask for our catalog and a sample COPPERHORN.

FORD
METER BOX
CO.,
WABASH, IND.

the following: The accompanying illustration reveals the fact that the valve has two sides—the inlet and the exhaust sides. On the left is the vacuum relief and purging port which remains tightly closed as long as there is a positive pressure on the line an tank. The basketed float ball of corrosion proof construction is forced tightly against the special seal producing rubber gasket. If the pressure goes off the line and a vacuum ensues for any reason it is self evident that the ball drops to the bottom of its basket and air enters to preclude a serious vacuum being formed within the line or tank. A stressed feature is the large port, which permits large volume intake at rapid rates; likewise, rapid air expulsion when pressure is returned to the line, thus rendering rapid refilling possible without need for further venting.

The air-venting (release) side of the valve in the right accumulates air until the liquid level has been forced down part way on the ball float. The ball drops, therewith, to open the small venting port and release air until the rising liquid floats the ball to close the port.

A special feature of interest in the closing-off valve (the rod in the center), which is opened or closed from the outside. Thus the main body of the valve may be closed off from the line at any time to permit removal of the head plate for inspection or any maintenance work that may become necessary due to foreign materials entering the valve chamber. The small venting valve is removable without ruinning the head plate; but, being protected by the guide and limit control plate, drilled with small holes, this unit is kept exceptionally free of trash or particles of size to give trouble.

The illustration pictures the Type A Ryan Air-Venting and Vacuum-Relief Valve. A Type B unit is available also. It represents the air-venting half of the Type A combination valve and is offered where vacuum-relief or the pumping features are not required.

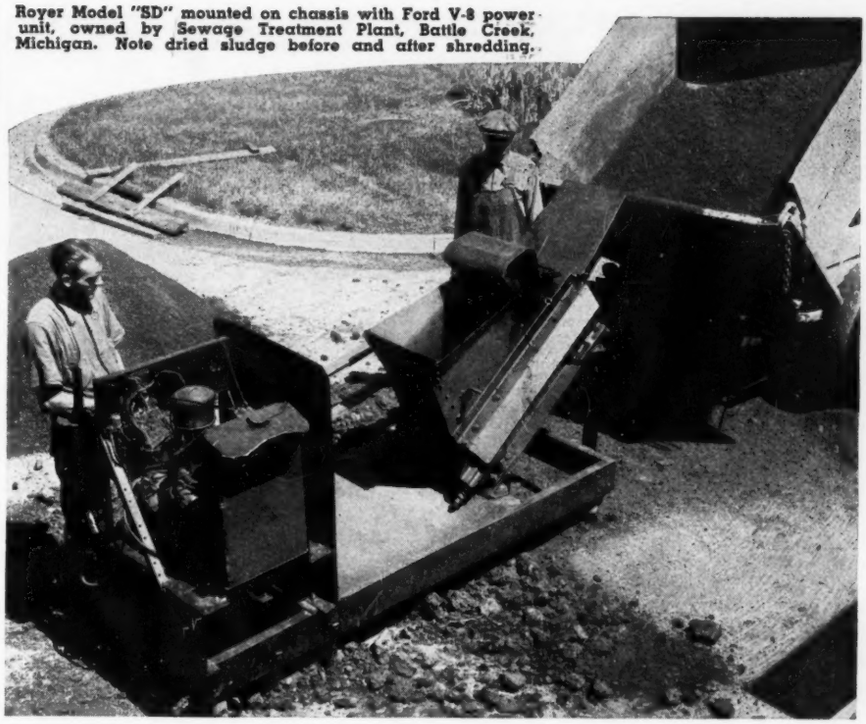
For illustrated Bulletin-100 and additional information, write The Fred J. Ryan Co., 5244 Germantown Ave., Philadelphia, Pa.

Turbines New Engine Powered Sewer Cleaning Winches

• Turbine Sewer Machine Co. of Milwaukee, have developed a completely new and economical self-powered Sewer Cleaning Winch, especially designed for the smaller sized communities which have heretofore considered self powered units of this type to be more than the municipal pocket book could stand.

The accompanying picture is one of a pair of Turbine's new Type JR-50 Engine Powered Sewer Cleaning Winches, for setting up at manholes and drawing sewer cleaning buckets and de-rooting implements from manhole to manhole by cable. The machine is self-powered

Royer Model "SD" mounted on chassis with Ford V-8 power unit, owned by Sewage Treatment Plant, Battle Creek, Michigan. Note dried sludge before and after shredding.



Plants must eat too!

See the Royer at the 2nd Annual Convention, Federation of Sewage Works Associations, Oct. 9-11, Hotel Pennsylvania, New York.

Officials of Battle Creek, Michigan, the "Nation's Breakfast Food Capital," realize that plants have to have their vitamins, too — and they have capitalized on this knowledge by converting sewage sludge cake, from their modern well-coordinated sewage treatment plant, into plant food.

You can eliminate sludge burial or incineration costs and realize a profit, too, by putting a Royer Sludge Disintegrator to work at your plant. Additionally, you perform a public service by establishing a dependable source of soil building material, much needed in most communities.

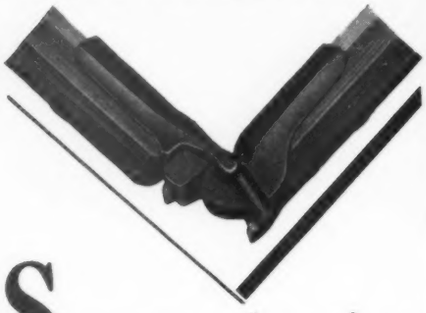
The Royer shreds sludge, reducing it to pea-size particles, at the same time aerating it and further drying it. Material with a moisture content as high as 51% is readily handled. Enrichening or neutralizing materials such as ammonium sulphate or lime are readily mixed in in any proportion, enhancing the value of the sludge.

Get the complete money saving facts — know why over 3,400 Royers have been sold — twelve stationary and portable models — a model for every plant.

THE ROYER

ROYER FOUNDRY & MACHINE CO.
170 PRINGLE ST., KINGSTON, PA.

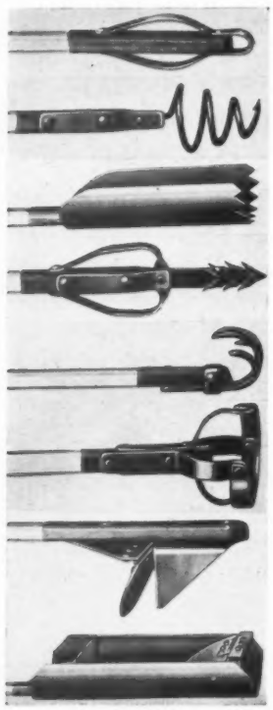
"Since 1901 America's Finest"



Sewer cleaning EQUIPMENT

"TAKE your sewer cleaning problems to Stewart," who offers you a complete line of modern equipment and tools for all sewer cleaning operations. Used for years by hundreds of municipalities. Stewart sewer cleaning equipment will save you money on your next sewer cleaning job. All items may be had on approval. Write for our new illustrated catalog.

Complete line of hand tools.



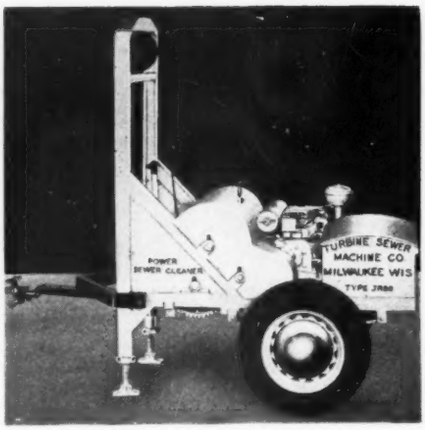
1. Leader — Jumbo Leader
2. Screw
3. Gauge
4. Spear
5. Claw
6. Plunger
7. Hinge Hoe Scraper— 4" to 12"
8. Scoop — 4" to 12"

W. H. STEWART

SINCE 1901

P. O. Box 767
Syracuse, N. Y.

P. O. Box 581
Jacksonville, Fla.

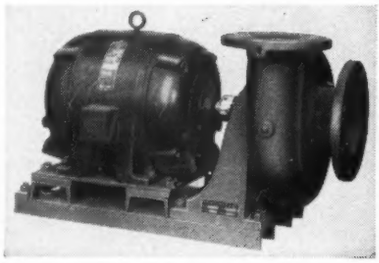


by a compact air-cooled gasoline engine and is claimed to be powerful enough to do everything that the- well-known larger power driven machines will do.

The new JR-50 has a tool-box and level winding attachments, and is especially designed for cleaning sewers of 6" to 24" diameters inclusive. We understand that this little "bull-dog" of a power cleaning machine costs just about half as much as the earlier large units.

For descriptive literature and specifications, write Turbine Sewer Machine Co., Milwaukee, Wis.

New Short Coupled Pumps by F-M

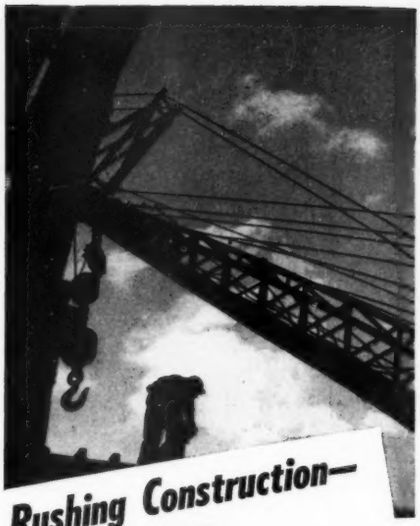


• Fairbanks, Morse & Co. have made another addition to their precision made pumps for many purposes. The latest announcement is the new line of Horizontal Short-Coupled Base Mounted Pumps for low head service.

These Figure 6720X pumps are designed primarily for pumping into the open, such as an irrigation, drainage, raw water and sewage service, and are not intended for pressure pipe line service.

The standard unit is supplied complete with motor, base and coupling. The pump is so constructed that no bearings are necessary in the pump itself and the motor bearings are grease packed at the factory so the unit requires a minimum of attention and maintenance.

The impeller position can easily be adjusted by loosening the set screws in the bronze shaft collar and shifting the pump shaft. When wear occurs, close clearance can thus be re-secured between the impeller and the volute and the original high efficiency of the pump maintained.



Rushing Construction— SPEEDING PRODUCTION

CLATTERING air hammers, roaring bulldozers and clanging well casing noise dins the air throughout the country. Defense projects are being rushed—production is going up,—up—and up! But the entire program is moving on a simple life necessity—Water!

Almost before the first transit is leveled, Layne men are on the job, rigs are up and the drills are biting through soil, clay, rock and on to water bearing formations. In record time you'll hear the hum of powerful motors and the splashing of cool clear water. Such is the tempo of today's unparalleled activity as the Nation faces an unpredictable future.

Keyed to the ever increasing and extremely urgent need for speed in production is Water! And wherever the Pump and Well is of Layne build, there you will find dependable performance no matter how heavy the load or prolonged the run.

Never has the Layne Organization been so keenly alert to its task of producing great quantities of water with utmost speed. Never has it been operating more efficiently. If you need more water to further speed production, write or wire

LAYNE & BOWLER, INC.
Memphis, Tenn.

LAYNE
PUMPS & WELL WATER SYSTEMS

AFFILIATED COMPANIES

Layne-Arkansas Co.	Stuttgart, Ark.
Layne-Atlantic Co.	Norfolk, Va.
Layne-Central Co.	Memphis, Tenn.
Layne-Northern Co.	Mishawaka, Ind.
Layne-Louisiana Co.	Lake Charles, La.
Layne-New York Co.	New Cork City.
Layne-Northwest Co.	Milwaukee, Wis.
Layne-Ohio Co.	Columbus, Ohio.
Layne-Texas Co.	Houston, Texas.
Layne-Western Co.	Kansas City, Mo.
Layne-Western Co. of Minnesota	Minneapolis, Minn.
Layne-Bowler New England Corp.	Boston, Mass.
International Water Supply	London, Ontario, Can.

These new pumps are driven by Fairbanks-Morse ball-bearing motors, equipped with the modern and much heard of feature, the famous Copper-spun Rotor. An advantage noted is that both the pump and the motor are designed and built complete by one reliable manufacturer, thus centering responsibility for satisfactory performance in the single purveyor.

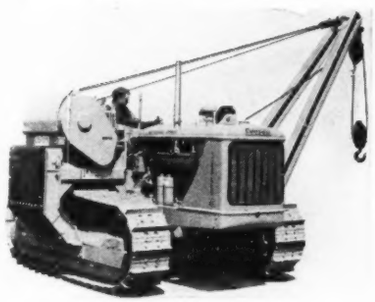
Another feature of the pump is that the semi-trash impeller passes large solids which makes this pumping unit admirable for sewerage, drainage, irrigation, and any other service where considerable debris may be encountered.

Still another feature is that when pumping out of a shallow well or sump, these pumps can be installed at ground level, or if the liquid to be pumped is beyond suction lift, it can often be brought within reach by installing a pump in a dry pit. The compact, close-coupled, construction requires a pit of minimum size.

Capacities start at 150 G.P.M. (1½ in. size passing 1″ diam. solids) and run to 3500 G.P.M. for the 8 inch pump which will pass solids up to and including 4″ diameters.

An attractive four-page bulletin describing the complete new line of 6720X motor-driven short-coupled pumps can be had from Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago.

New Trackson Pipe-Layer



Trackson Co. of Milwaukee, announces a new Model MD6 Pipe-Layer, a tractor side-crane that mounts on the new "Caterpillar" D6 model and takes full advantage of the increased power, ease of control and other improvements built into this latest "Caterpillar" Tractor.

The new MD6 Pipe-Layer has a lifting capacity ranging from 7300 lbs. at 12 ft. overhang, to 23,700 lbs. at 4 ft. over-hang, and is one of complete line of Trackson Pipe-Layers available with lifting capacities up to 67,000 lbs.

These husky "Caterpillar" tractor-mounted side-cranes have the power, speed and traction required for all conditions encountered in construction work. They combine abilities to lift heavy loads, carry them at tractor speeds in mud, sand, or other troublesome terrain, operate with ease in cramped quarters, and can be equipped with the Trackson "Anglefiller" that

(*Continued next page*)

An Invitation to Smooth Sailing!

- *DUSTLESS BLACKALUM*
- *STANDARD ACTIVATED ALUM*
- *CHAMPION ACTIVATED CARBON*
- *PALMER FILTER AGITATORS*

Yes, it's smooth sailing when you use these fine Activated Alum Corporation products. Ideal for "PROBLEM" filtration.

It is possible that Activated Alum engineers could point out unsuspected but profitable applications of one or more of these products in your plant as they have done in numerous others. Their knowledge and experience are always at your service.

Everybody Likes Activated Alum

STUART-BRUMLEY CORP.

EXCLUSIVE SALES AGENTS FOR ACTIVATED ALUM

516 N. Charles St. **Baltimore, Md.**

The Meter-Master

RATE RECORDER FOR WATER METERS

Send For Literature

F. S. BRAINARD & CO.

244 Pearl Street, Hartford, Conn.

CAST IRON PIPE

The Standard Material

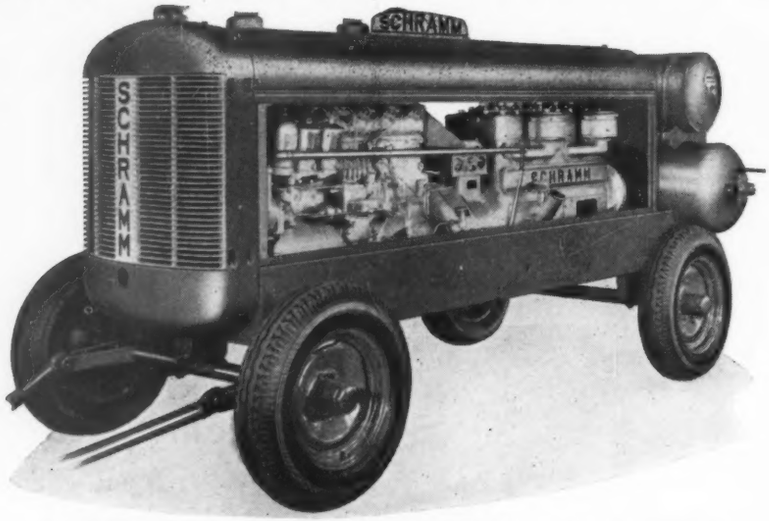
for

Underground Mains

THE CAST IRON PIPE RESEARCH ASSOCIATION

Thomas F. Wolfe, Research Engineer
1015 Peoples Gas Bldg. Chicago, Ill.

SCHRAMM BUILDS 'EM BETTER



SCHRAMM 315 cu. ft. Diesel Engine Driven Air Compresser.

● **FOR EVERY AIR NEED** ●

THE MODERN COMPRESSOR FOR

WATER and SEWER DEPARTMENTS

Sizes 20 to 420 cu. ft. actual air delivery.
Gasoline or Diesel engine drive.
Write for Catalog No. 42-P.

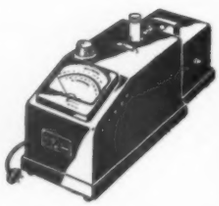
SCHRAMM, Inc., WEST CHESTER, PA.

Leading Apparatus

for the **WATER WORKS** *and* **SEWERAGE LABORATORY**

The HELLIGE TURBIDIMETER. Turbidity measurements (SiO_2) and sulphate determinations can be made with greater simplicity and speed *without* the preparation and use of standard suspensions. Reads all turbidities down to zero.

HELLIGE COMPARATORS are unsurpassed in durability, handiness, and convenience. Perpetually accurate glass standards are available for pH control and all popular A.P.H.A. and A.W.W.A. methods.



The HELLIGE - DILLER PHOTOELECTRIC COLORIMETER is a precise photoelectric instrument for accurate and *always* reproducible colorimetric determinations. No standards required. Ideal for the determination of minute quantities of phosphorus, silica, sulphates, chlorides, and dissolved oxygen.

HELLIGE GLASS ELECTRODE pH-METERS—COUNTING APPARATUS—COUNTING CELLS AND MICROMETERS.

Write today for informative 28-page bulletin No. 602.

HELLIGE, INC. 3718 NORTHERN BLVD. LONG ISLAND CITY, N.Y.

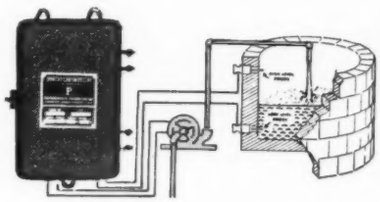
HEADQUARTERS FOR COLOR STANDARDS AND COLORIMETRIC APPARATUS

permits any Trackson Pipe-Layer to bulldoze, backfill, level or spread.

Compact and agile, these machines do many things well and economically in the construction field including laying mains for water, gas and sewers; handling and placing poles and piles; erecting steel work; and, in general, making themselves construction-useful.

The newly announced Model MD6 Trackson Pipe-Layer here pictured is further described in Bulletin 459, available from Trackson Company, Milwaukee, Wis.

Photoswitch Level and Pump Control System



• Photoswitch, Inc., of Cambridge, Mass., offers an Electronic Level and Pump Control System for tanks, sumps, etc., which depends upon stationary electrodes rather than floats and switches or contact making points.

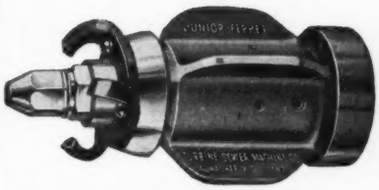
Known as the Series P-16, which is the type especially suitable for control of water or sewage levels or pump operations, the Photoswitch Level and Pump Control consists of proper electrodes inserted through or properly attached to the inside walls of tanks, pump sumps, etc. One electrode is set at the level in the reservoir or tank at which it is desired to have pumping begin and the second electrode is located at the elevation at which pumping should cease. Thus, the system is adaptable to control in pumping into tanks or reservoirs; or, to pumping out of sumps or pits, such as in sewage, industrial waste or drainage pumping. The system is also employed in the control of boiler-feed water injection automatically.

The electrodes are wired to the remote control unit mounted on the pump-station wall. In the case of water tanks, as long as the lower electrode unit is submerged a small amount of current trickles through the wired control circuit, and the pump starting switch is held open. As soon as the water drops below the lower electrode unit current flow ceases, since there is no longer the conducting liquid between the elements of the electrode, and the pump switch is released. The tank then fills until the upper electrode is submerged (becomes conductive) and allows a trickle of current flow that actuates the control unit which in turn throws the pump switch and pumping ceases.

From the above explanation it is apparent that by switching the connec-

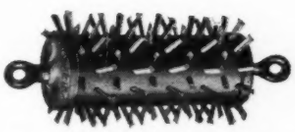
(*Continued next page*)

Sewer Cleaning Equipment

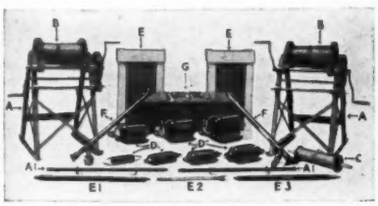


Self-Propelling Junior Ferret Turbine.
USED 6"-12" PIPES

Improved Rubber Jacket Flushing Bags.
ALL SIZES



Turco Hercules Sewer Brushes.



Turbine Sewer Drag System.

TURBINE SEWER MACH. CO., INC.

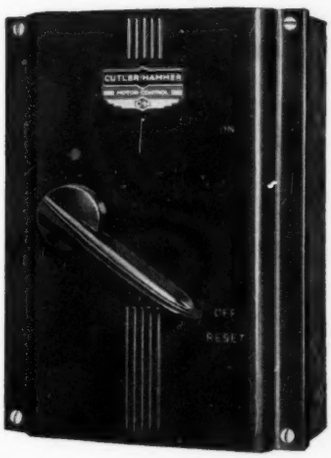
Office and Factory:
52nd & W. State St., Milwaukee, Wis.

N. Y. C., 276 Lafayette St.

tions of electrode lines in the control unit the reverse sequence of pump operations is effected, such as is required in the control of pumping down of sumps, collecting wells, etc. However, this change in internal wiring of the control unit is made by the manufacturer who supplies either type specified.

A four page illustrated pamphlet (No. 1000) gives further details and prices. For a copy write Photoswitch, Inc., Cambridge, Mass.

Reasonably Priced Circuit Breaker



• Cutler-Hammer announces a new circuit breaker at a cost little above that of a type A switch, the latter being expected to advance a wider use of circuit breakers the use of which has been limited because of their relative cost in comparison to switch units.

The new C.-H. Multi-Breaker promises exceptionally economical application as a motor circuit switch or service disconnect switch. It is fuseless, with bi-metallic strip actuation, visible trip indication, and trip free lever. It is quick make and quick break, with a rated capacity of 230 volts from 15 to 100 amperes, available in 3 pole, 3 pole solid neutral or 4 pole solid neutral types. Calibration is set at the factory and cannot be tampered with. The breaker is completely enclosed and semi-dust-tight. Front access and operation make this breaker convenient, compact and economical of space.

For a descriptive bulletin, write Cutler-Hammer, Inc., Milwaukee, Wis.

Studebaker's New Hydraulic Vise

• A new hydraulic vise, said to offer considerable savings in time and labor, has been introduced by the Studebaker Machine Co., of Chicago.

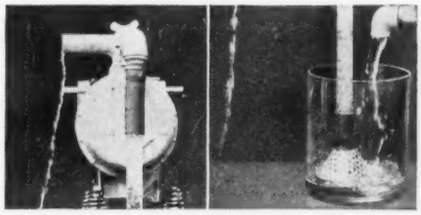
Capable of developing pressures up to 5 tons between the jaws, if needed, the new vise is designed to speed up small press and cutting operations, as well as ordinary vise work.

(Continued next page)

IT'S A Pip of a Pump

FOR LARGE VOLUMES

Watch a Homelite gasoline-engine-driven pump in action and you wonder how it packs such a punch. 15,000 gallons per hour for a 91-pound pump is some going. But that is exactly what you get with the Homelite 3" pump.



FOR SEEPAGE

Being completely self-priming, a Homelite can bring itself right down to a trickle—keeping seepage at strainer level at all times *automatically*. Moreover it has a suction lift of 28 feet, *guaranteed*.

FOR WATER THICK WITH SOLIDS

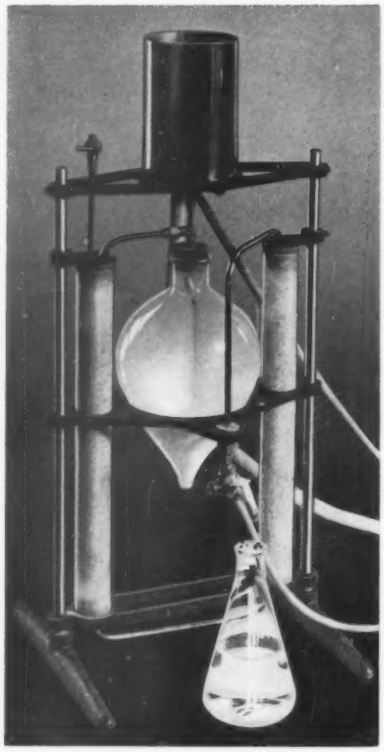
No choking up with a Homelite. It handles 35% solids—sludge, sewage, muddy or sandy water without clogging. There's no time out for cleaning. No delays. A Homelite pump is built to do the kind of pumping you want day in and day out without trouble.

Send for bulletin

HOMELITE CORPORATION

2509 Riverdale Ave., Port Chester, N. Y.

Announcing **THE NEW**



ENSLOW STABILITY INDICATOR

Completely redesigned to embody improvements suggested and developed by practical water works men under actual plant operating conditions.

Conceived by L. H. Enslow, this apparatus provides a continuous index of corrosivity or stability of water, with nothing more involved than alkalinity filtrations and **no** complicated calculations.

In operators' opinions **"an invaluable aid"** in the control of stabilization and anti-corrosion treatment.

Write for descriptive literature.

PHIPPS & BIRD, INC.
RICHMOND, VA.

"SOUTHERN CENTER FOR LABORATORY APPARATUS AND CHEMICALS"

84" pipe—Spring Lake, N. J.

FLANGED PIPE
FLEXIBLE JOINT PIPE
BELL & SPIGOT PIPE
SPECIAL CASTINGS
SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.
11 Broadway, New York

Warren Pipe Company of Mass., Inc.
75 Federal St., Boston

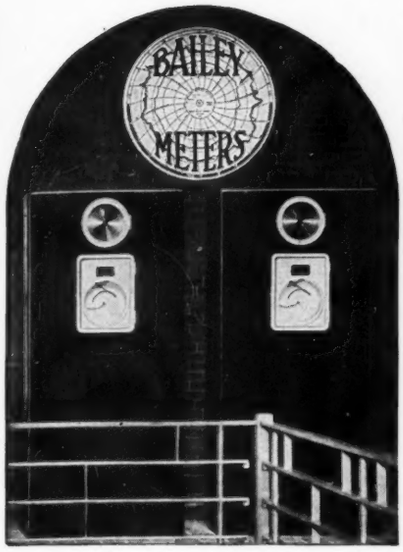
The new Studebaker Hydraulic Vise is operated entirely by foot control, permitting the use of both hands in setting up and removing work. The unit is self-sufficient—no outside power is needed. Pressure to close the jaws is controlled by a foot pedal pump arrangement in a pedestal mounted on the floor. The latter is connected with the vise proper by a steel tube. Stepping on one pedal moves the rear vise jaw to contact against the work. A second pedal applies pressure up to 5 tons if needed. A third pedal releases the jaw. Because the operator can use both hands, exceptionally heavy work can be easily handled and with a degree of precision heretofore impossible.

The vise mounts horizontally on any type of bench, and also vertically on wall or post. In addition, it can be mounted on a portable stand, as a movable, self-contained unit. Special jaw faces can be applied.

Other features of operation are the speed which saves time and labor, absence of a protruding handle, force centered in the jaws and not under them, accurate work due to the precision fit of the jaws, and the fact that it mounts as a fixture on drilling machine, shaper, miller, or grinder. Construction is all semi-steel, and the hydraulic pump is precision fitted to insure accurate operation and long life.

Two sizes are available in the new vise —5" width between jaws and 7½" width.

A new bulletin gives complete information about the novel Studebaker Hydraulic Vise. For a copy, write the Studebaker Machine Co., 9 South Clinton St., Chicago.



When You Specify
Meters and Recorders
Be Sure To Demand

•ACCURACY •RELIABILITY
•SOUND ENGINEERING
•MODERN APPEARANCE

Regardless of whether your problem calls for the use of a Venturi Tube, Weir, or Flume, you can depend on Bailey Meter Company to design and construct both the primary element and the register for maximum accuracy.

A vast amount of experience gained from thousands of installations of metering equipment, together with extensive experimental work in our own hydraulic laboratory and in the laboratories of the Ohio State University, Cornell University, Case School of Applied Science and other institutions, is back of every Bailey Primary Element.

The reliability of Bailey Meters and Recorders is attested to by the fact that thousands of dollars worth of steam and water are sold monthly and billed solely on the basis of readings from Bailey Meters.

No small share of the accuracy and reliability of Bailey Meters is due to the conservative engineering policy of the Company. New ideas and designs are not offered for sale until they have been thoroughly tested both in the laboratory and in actual service.

Bailey Meters, Recorders and Controllers present a thoroughly modern yet conservative appearance.

Write for your copy of Bulletins No. 301 and 302, describing Bailey Fluid Meters for steam, liquids, gases, sewage, sludge, and compressed air.

MU-16

BAILEY METER • COMPANY •

1072 Ivanhoe Road, Cleveland, Ohio

BAILEY METER COMPANY LTD., MONTREAL

Falk's Protective Piloted Couplings

• The Falk Corporation of Milwaukee has added a new coupling to its line of Steelflex Couplings, known as Type P—Piloted Couplings for floating shaft requirements.

This new coupling combines the resiliency and shock cushioning section of the Falk General Duty Steelflex Coupling with universal joint action. This feature makes possible large savings in installation costs and freedom from bearings worries. The new Piloted Couplings also permits greater flexibility in locating the driving and driver units.

These couplings are made in three types: (1) The Type P Singled Piloted Coupling, which will support a long shaft without using inboard bearings on the extended shaft. (2) Type P Double Piloted Horizontal, in two couplings with a connecting shaft. (3) Type P Double Piloted Vertical, also consists of two couplings and connecting shaft, and is ideal for vertical drive requirements, when it is desirable or necessary to have considerable distance between the motor and the pump

For further details regarding these installation simplifying couplings for horizontal or vertical drive write the Falk Corporation, Milwaukee, Wis.

TAPAX

The ORIGINAL and FINEST....

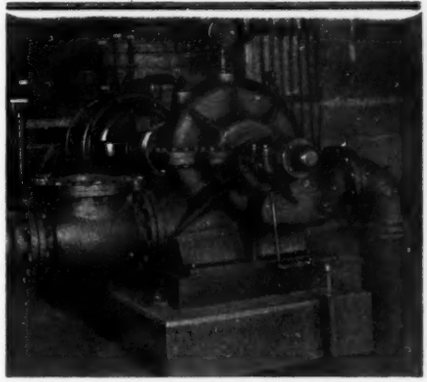
Manhole Cushion U. S. Pat. No. 2,050,050 offers you the simplest solution for noisy, rattling covers. Easy to install. Lasting — Economical.

Write for story of Tapax and Trial Offer.

TAPAX MFG. CO., INC.
MAMARONECK NEW YORK

The MORRIS HYDRAULIC COLUMN

News of interest to Centrifugal Pump Users



When new pumps are to be purchased . . .

Morris Pump performance has won the hearty commendation of water works and sewage plant officials all over the country because of the high efficiency and thoroughly dependable and trouble-free operation which uniformly characterizes each Morris installation.

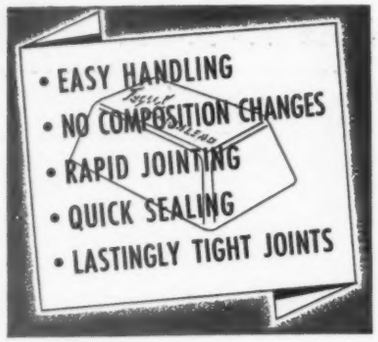
You will be safe in specifying Morris Pumps for every municipal service. Write for catalogues describing Morris pump designs for services in which you are interested.

Replacements with a bonus

On severe services, pump parts which are subject to wear are bound to give out eventually. When they do, a replacement becomes necessary, and this is where you can get a bonus from Morris. Recent advances in Morris Pump designs have developed such astonishingly high efficiencies that a new Morris impeller, suction throat ring or casing will frequently produce a marked decrease in power consumption as well as equalling or even exceeding the original pump capacity. Remember the Morris bonus when you need new parts for old Morris installations or need new pumps for any requirement.

MEMBER

For authoritative recommendations on any pumping problem, write to Morris Machine Works, Baldwinsville, N. Y. Representatives in principal localities. *Export Office*, 50 Church St., New York.



This, concisely put, is what you get when you use *Tegul*-MINERALEAD in jointing your Bell and Spigot Pipe. • The ingot form is impervious to rain and flood. • This compound works with pipe of any diameter, isn't bothered by terrain conditions and has the stamina to withstand far greater vibration and punishment than it will ever meet in service. • The cost will surprise you pleasantly. • For complete information, write The ATLAS MINERAL Products Company of Pa., Mertztown, Pennsylvania.

Tegul- MINERALEAD

For Jointing Bell & Spigot Pipe

WITH THE MANUFACTURERS

Pittsburgh-National Opens Swanky Boston Quarters

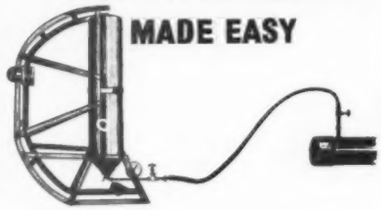
E. P. Lufkin, District Manager

• The National Meter Division of the Pittsburgh Equitable Meter Co. on September 1st became established in new and larger quarters in Boston, consisting of offices and warehouse at 708 Beacon St., in centrally located Kenmore Square.

For over 50 years the National Meter Co. has served the New England area through their Boston factory branch, for the last ten years at 368 Congress St. in Boston. At the new location, under the name "Pittsburgh-National Meters," a full stock of both Pittsburgh and National oil and water meters will be carried. Parts and accessories as well as complete service and repairs will be available at this new address.

The sales and service in New England will be under the direction of Mr. Eben P. Lufkin, district manager, whose father was connected with the National Meter Co. for nearly 50 years, and who served as their New England manager for 35 years prior to his retirement January 1, 1941.

SAND FILTER CLEANING MADE EASY



A simple but effective method of cleaning sand filters with ESOTOO*—tested and proved successful in actual operation—is fully explained in new bulletin "A Method of Cleaning Filter Beds with Sulfur Dioxide."

Isn't it worth your consideration? Write today.

V VIRGINIA

*"ESOTOO" is Virginia's Trade Name for Liquid Sulfur Dioxide.

VIRGINIA SMELTING COMPANY
WEST NORFOLK, VIRGINIA

Connelly IRON SPONGE

Wherever SEWAGE GAS IS UTILIZED!

If you are making use of sewage gas in your plant you should protect your valuable equipment against sulphur damage. This costly damage is being eliminated in leading plants thruout the country by the Connelly method of gas purification. Let Connelly engineers show you how this danger can be stopped — easily — quickly — economically.

OTHER CONNELLY PRODUCTS

Connelly Manometer or U-Gauge. Made for portable or stationary use. Tubes of unbreakable plastic. Sturdily built —accurate—dependable. Write for bulletin No. 401-B-1 describing the complete line.

Connelly H2S Tester. An accurate instrument for testing giving a permanent record for future reference. Convenient —dependable. Write for illustrated bulletin.

CONSULT

Connelly Engineers about your purification problems. No cost or obligation.

CONNELLY
IRON SPONGE & GOVERNOR CO
CHICAGO ILL. - ELIZABETH N. J.

SERVICE WORK —*made easy!*

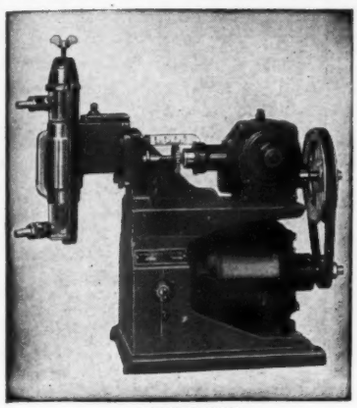
HOW? Simply use Dresser Style 38 Service Couplings for repairing defective services or renewing mains . . . eliminate threading, exact pipe lengths, work trying to screw fittings on. All you have to do to make new connections is to cut the pipe, slide the coupling on, tighten bolts, and the job is done! Style 38 Service Coupling is permanently tight, flexible, is installed with only a wrench, takes plain-end pipe, acts as a union, and makes exact lengths of pipe unnecessary. Sizes from ⅜" ID up.

We will gladly send you a free sample on request. Just specify "Style 38" and mention pipe size.

DRESSER MANUFACTURING CO.
415 Fisher Avenue, Bradford, Pa.

In Canada:
Dresser Mfg. Co., Ltd.
60 Front St., W., Toronto, Ont.

WILSON PULSAFEEDERS



TYPE DES

A
HYPO-CHLORINATOR
AND
GENERAL CHEMICAL
FEEDER
Available in Manual
Semi-Automatic—Automatics

There is a Pulsafeeder to give Perfect Results, whether the installation is a gravity water supply, pumped supply, or a swimming pool.

WILSON CHEMICAL FEEDERS, INC.
Buffalo, N. Y.

LEADITE

The Pioneer Self-Caulking Material for C.I. Pipe

W N S E

USED MOST EVERYWHERE!

Hundreds of water works men have used Leadite . . . saved with Leadite . . . proved the dependability of Leadite under most all conditions of bell and spigot water main construction.

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia, Pa.

No Caulking

Gordon Le Febvre Joins Cooper-Bessemer as Vice Pres and Gen'l Mgr.

Gordon Le Febvre

● Mr. Gordon Le Febvre, former General Motors and American Locomotive Co. executive, has recently been elected vice-president and general manager of Cooper - Bessemer Corporation, with important Diesel and gas-engine building plants at Mount Vernon, Ohio, and Grove City, Pa.

Mr. Le Febvre, a native of Richmond, Va., is a mechanical engineering graduate (1912) of the Virginia Polytechnic Institute. Prior to that his folks sent him to the U. S. Military Academy at West Point, but "the hill" wasn't big enough for Gordon.

With his V.P.I. "sheepskin" at the bottom of his trunk, Le Febvre set out for the shops of the North Western Railway, where he became a special apprentice and machinist. In 1915 he went to work as machinist for the Du Pont Co., soon became a master mechanic, and on up through the ranks went to mechanical superintendent. In 1919 he found his big opportunity by joining General Motors, where he was given charge of construction of the new Chevrolet plant in Detroit, and thereafter was placed in charge of Chevrolet's production under that big man, Wm. S. Knudsen.

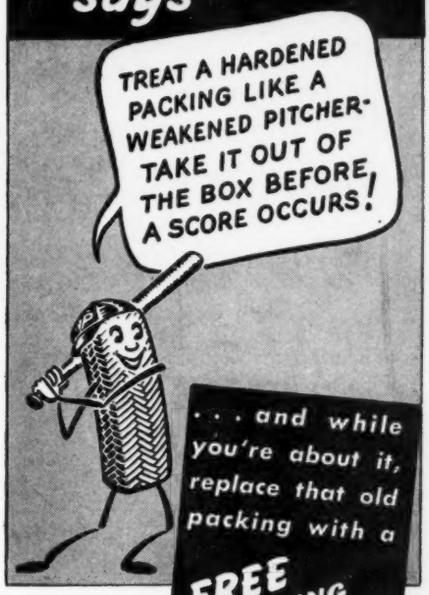
General Motors, on Knudsen's recommendation, sent Le Febvre to Canada and made him vice-president in charge of all of General Motors activities in the Dominion. At one time he was also vice-president in charge of operations of GM's fast moving Pontiac Division.

From 1932 to 1936, Mr. LeFebvre maintained a consulting practice, with Detroit offices, but gave that up to accept the position of General Manager of American Locomotive's new Diesel Engine Division at Auburn, N. Y., from which position he steps into the Cooper-Bessemer post.

In the water and sewage field Cooper-Bessemer is best known for its Diesel and gas engines, especially the latter in the sewage field, operating on by-product sewage digestion gas. To this progressive company Mr. LeFebvre brings not only an extremely valuable experience in engine building, but also a broad knowledge of plant management and production. His headquarters are at Cooper-Bessemer's Mt. Vernon, Ohio, plant.

[Ye Ed, who spent 3 years in Virginia Tech. with Mr. LeFebvre, said he could have made the early part of this story really interesting reading. However, he feared that possibly Cooper-Bessemer might never do any more advertising in "W. W. & S.," if that part of their new G.M.'s career story got into print.]

PALMETTO PETE says


TREAT A HARDENED PACKING LIKE A WEAKENED PITCHER- TAKE IT OUT OF THE BOX BEFORE A SCORE OCCURS!
. . . and while you're about it, replace that old packing with a
FREE WORKING SAMPLE of
PALCO*
SELF-LUBRICATING
PACKING

To receive a generous test sample of any of our long-wearing packings, just send us your name and address and specify the service conditions and size of the packing.

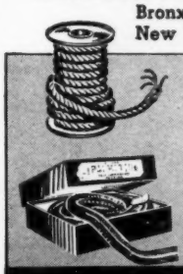
* REG. U.S. PAT. OFF.

Save your shafts

WITH PALCO*

Avoid scored shafts in your water pumps by using Palco Packing. Scoring is caused by hardened packing—but PALCO stays soft!! There's more lubricant in Palco—impregnated in every stand before braiding. That's the reason why Palco lasts two to three times longer than other packings. Change to Palco. You'll banish shaft scoring and cut yearly packing costs as well.

GREENE, TWEED & COMPANY
Bronx Blvd. at 238th Street
New York N. Y.



PALMETTO
for steam, hot water, air.
PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.*
SUPERCUTNO *for acids.*
KLERO *for foods, etc.* PALMETTO SUPERSHEAT
PACKINGS

9 out of 10 who try them, buy them

WHEN USING SUPER-CHLORINATION FOR TASTE AND ODOR CONTROL

LIQUID Sulphur Dioxide ANSUL

DE-CHLORINATE WITH ANSUL Sulphur Dioxide

Liquid sulphur dioxide possesses many advantages in economy and ease of handling, when used as a de-chlorinating agent where large amounts of chlorine are used for better taste and odor control. Sulphur dioxide, introduced into the water after chlorinating, removes excess residual chlorine.

Ansul's Technical Service is fully equipped to study your problem, and to engineer and supervise. Ansul Sulphur Dioxide is available in suitable-sized containers up to ton drums and tank-car quantities.

Write today for information on super-chlorination and de-chlorinating with Sulphur Dioxide, to Dept. WS . . .

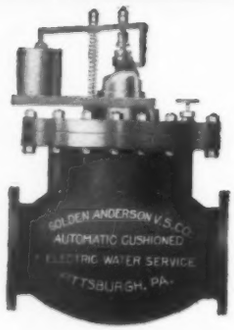
ANSUL CHEMICAL COMPANY
Manufacturers of Sulphur Dioxide for 25 years
MARINETTE • WISCONSIN

LIQUID Sulphur Dioxide ANSUL

Are you familiar with the easy, inexpensive method of cleaning filter beds with Liquid Sulphur Dioxide? Write for detailed information.

See page 74 of our new 96-page catalog for information on this

ELECTRIC WATER SERVICE VALVE

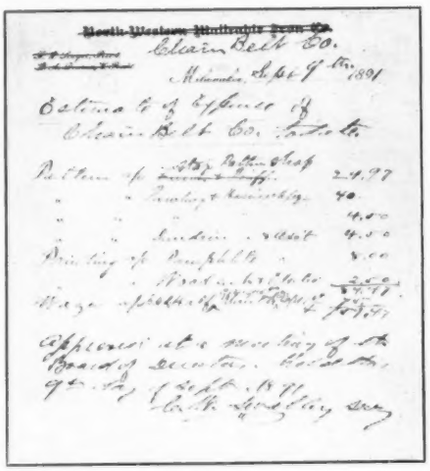


This Valve closes automatically whenever solenoid is energized, and opens whenever solenoid is de-energized—*or vice versa.* Solenoid is furnished for either AC or DC circuit for any voltage.

The Valve operates at all times, under any pressures, without shock or bang, owing to the inherent air and water cushioning.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
Fulton Building Pittsburgh, Pa.

Chain-Belt's 50th Anniversary



This Historic Document is Chain-Belt's First Expense Account. Dated Sept. 9, 1891.

(*Interesting are the two advertising items, amounting to* $10.50 *in the* $159.47 *total, showing that Chain-Belt was advertising-minded from the first.*)

• On September 9th Chain Belt Co. of Milwaukee looked back at 50 years of history behind this wide-world known manufacturing enterprise, which began on $225.00 in cash as a producer of an improved type of drive chain to replace leather belts in driving agricultural machinery.

When surveying the 1941 properties of Chain Belt Co. and considering its $7,300,000 capital structure, it is not easy to picture the beginning of such an enterprise in a small rented second floor shop, with only a few tools and nothing more in the way of assets than the ideas of one man with the faith and money of friends behind him.

However, the new Detachable Chain idea went over and by 1900, chain belts were being made for specific uses in a number of other industries. In 1902 the company erected the first building of its own, and this represented the beginning of expansion and more products manufactured. In 1908 the first Chain Belt Concrete Mixer was offered. Its success placed the company firmly in the construction field, and products were added one by one until in 1933 the rather revolutionary concrete pumping and delivery system, known as "Rex" Pumcrete, was announced. This system pumps wet concrete from central mixing stations to various points of use on a project.

In 1926 a line of belt idlers was developed and only recently the company supplied over 16,000 such idlers for the 9.6 mile belt-conveyor now being used in the construction of Shasta Dam —representing the longest belt-conveyor ever conceived or built. The production of Chain Belt Screw Conveyors began only in 1938.

(*Continued next page*)

IF Your SEWAGE effluents are high in suspended solids;

Or, you have a WATER PROBLEM;

Or, desire to RECOVER a product now wasted;

Or, you are disturbed by STREAM POLLUTION;

Or, are in any way interested in the removal of suspended solids from liquors;

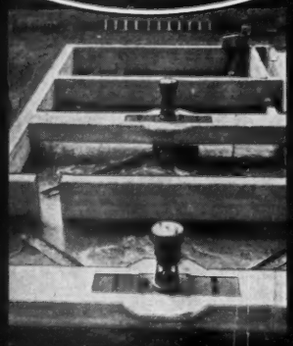
You should investigate the

Laughlin Modified Rapid Sand Filter

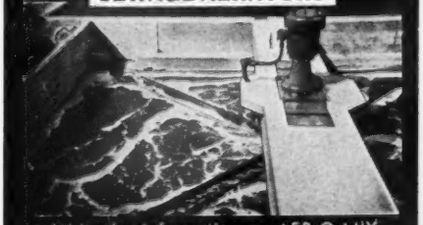
BECAUSE, it is a simple automatic, continuous flow apparatus, designed on familiar lines, to accomplish a purpose without adding to the operator's troubles.

LAUGHLIN EQUIPMENT CORPORATION
270 Madison Ave., New York City

AER·O·MIX
AERATOR—MIXER



Down-Draft Type MECHANICAL SEWAGE AERATORS



Write for information on AER-O-MIX for your SEWAGE or WATER TREATMENT APPLICATION.

VOGT MFG. CO.
INCORPORATED
P. O. Box 1122 Louisville, Ky.

WATER TREATING EQUIPMENT

Gravity and Pressure Filters, Softeners, Recarbonators, Chemical Diffusers, Cooling Towers, Standard and Special Equipment for any Water Treating Problem

MUNICIPAL SERVICE CO.

Dwight Bldg., Kansas City, Mo.

7 REASONS

Why Water Departments Choose Dresser Bell-Joint Clamps for Permanent Repair of Bell-and-Spigot Leaks

1. ADJUSTABILITY—makes fitting of both odd-size and standard bells easy, quick.
2. CORRECT GASKET DESIGN—generous-size gasket extends well up face of bell; provides pressure-tight seal; no protective parts needed.
3. QUICK AND EASY INSTALLATION—without interrupting service, using only a wrench.
4. HIGH-STRENGTH MALLEABLE IRON—developed for highest strength and ductility.
5. BALANCED, RUGGED CONSTRUCTION—ample strength at all points.
6. RESERVE SEALING POWER.
7. COMPLETE SIZE RANGE—standardization in all sizes cuts inventories.

DRESSER MFG. CO • *Bradford, Pa.*

In 1930 the company embarked on the manufacture of special sanitation equipment, now widely used in the treatment of water, sewage and industrial wastes. This line of equipment has constantly grown, until today it includes sludge collectors of both the chain-drawn cross-channel conveyor type and the revolving arm suction type Tow-Bro Conveyor, developed at the Milwaukee plant; mechanically cleaned bar-screens; screenings "Triturators"; grit collectors and washers; flocculators; and a process of high-rate sewage filtration, which is amongst the latest of modern sewage treatment developments.

Chain-Belt's policy of promotion from within is well illustrated in the recent election of Mr. J. C. Merwin to its presidency. Mr. Merwin joined Chain-Belt in 1917 as a plant superintendent.

The accompanying reproduction of the first expense sheet (budget), approved by the Board of Directors of the company on Sept. 9, 1891, for the first month of operations, is interesting. Two items in the total of $159.47 especially interest us. Chain-Belt's management was apparently advertising-minded from the very beginning, for itemized are expenses of "wood-cut—$2.50" and "Printing of Pamphlets—$8.00." Of the $159.47 then, Chain-Belt's first "advertising budget" was $10.50. Too bad we haven't the information as to what Chain-Belt's advertising budget has grown to 50 years later.

"Bill" Herron Joins Pittsburgh-National

● William L. Herron has joined the Worthington-Gamon Meter Co. as its representative in New York state.

For eighteen years Mr. Herron represented the National Meter Co. in New York state. Prior to his association with National, he was assigned several patents evolving from research work as a mchanical engineer. He has written several technical papers, and is author of "Romance of the Water Meter."

A member of the A.W.W.A., maintaining an active interest in its N. Y. State Section, and of the A.S.M.E. and the N. Y. State Society of Professional Engineers, Mr. Herron will also collaborate in developments and investigations conducted in the enlarged laboratory of the Worthington-Gamon Meter Co.

Michigan Alkali Moves Sales Headquarters to Detroit

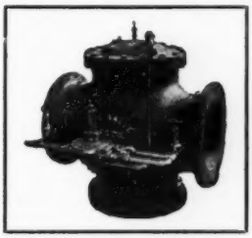
● The Michigan Alkali Co. announces the consolidation of its general sales and executive offices, which now are located at the Ford Building, Detroit.

An Eastern branch office will be maintained at 60 East 42nd Street, New York. Other branch offices are located in Chicago, Cincinnati and St. Louis.

ROSS

AUTOMATIC VALVES

Reducing	Combination
Relief	Surge
Altitude	Float
Back Pressure	Differential



ALTITUDE VALVE
for
Control of elevation and heads into and out of tanks, basins and reservoirs.

ROSS VALVE MFG. CO., Inc.
P. O. Box 595 Troy, N. Y.

HYDRO-TITE

A DEPENDABLE self-caulking joint compound used to joint cast iron bell and spigot pipe. Much easier to use than lead and makes stronger, more flexible and tighter joints.

Employed on thousands of miles of pipe from 4" to 60". Write for our free trial offer.

HYDRAULIC DEVELOPMENT CORPORATION

MAIN SALES OFFICE - 50 CHURCH STREET, NEW YORK
GENERAL OFFICES AND WORKS - WEST MEDFORD STATION BOSTON, MASS

OVER 25 YEARS WITHOUT A FAILURE

EDSON'S NEW HAND PUMP

Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 55 lbs.

THE EDSON CORP'N
49 "D" Street
So. Boston, Mass.

NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 1061 Peoples Gas Building

Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

The Langelier
MOTORIZED WATER HARDNESS APPARATUS
for the rapid and convenient determination of CaH and MgH, separately or combined. Write for details.
Chemlab Specialties Co.
52 Alvarado Road
Berkeley, California

STOP
JOINT LEAKAGE
with CARSON
MECHANICAL JOINTS
● CHARCOAL IRON BOLTS ●
for Cast Iron Pipe and Fittings
(Also Leak Clamps)
WRITE FOR PRICES
CARSON CADILLAC COMPANY
1221 PINSON ST. BIRMINGHAM, ALA.

Used Backfiller

A versatile machine with 3-drum arrangement; will handle a wide variety of work, including pushing, pulling, lifting work as well as numerous drum hoist applications. Travels fast, works fast, lifts up to 35,000 pounds. Equipped with 55 H.P. Waukesha Engine. Will sacrifice for quick sale.

Write or wire Robert E. Young, 4400 W. National Ave., Milwaukee, Wis.

Dresser Opens New Warehouse in Houston, Eex.

• Dresser Mfg. Co. of Bradford, Pa., has just opened a new warehouse in Houston, Texas, for the purpose of making available to the Southwest ready-made joints and Dresser Couplings overnight for speedy laying of pipe lines, or repairs to pipe lines and distribution systems.

The new Houston warehouse will save vital time by making it possible for users to draw on full stocks of couplings and other dresser products making 500 different styles and sizes available for immediate delivery, and permitting telephone or wired orders for over-night shipment.

The new Dresser warehouse—known as the Southwest Warehouse—is located at 1121 Rothwell St. in Houston with a Dresser veteran, Dave Geiser, in charge. C. T. (Charlie) Davis, District Manager of the Water and Gas Division, will also have his headquarters in new Houston office and warehouse.

F-M Announces Special Bonuses to Employees

• All employees of Fairbanks-Morse, who have been with the Company six months or longer, (other than company officials) will receive special bonuses amounting to 10% of monthly wages or salaries.

In making this announcement, Colonel R. H. Morse, F-M's president, said—

"These special bonuses will be in addition to those which may be earned under our regular profit sharing plan. It is our hope and belief that business will warrant payment of these bonuses for remaining months of the year."

Who Knows What a Phoenix Is?

• Most will say—"It's a meter."

Correct, but before that the original Phoenix was a bird of mythology. In Egypt it was a fabulously sacred bird of gorgeous red and golden plumage. When its life came to a close, after 500 years, it would build a nest of twigs from spice trees and, by fanning it with its large wings, would cause it to take fire and consume the sacred Phoenix. Out of its ashes would rise a new and more beautiful Phoenix.

This in part is the interesting "story of the Phoenix," which was recently distributed by the Phoenix Meter Co. in explanation of the "featured" trademark of the company, which to us was just a sea-gull in flight. Now we will see only the gorgeous sacred Phoenix in full flight when we look at the trademark of Phoenix Meter.

WESTON

GASKET AND FORM
The Perfected Method for Making SEWER PIPE JOINTS OF CEMENT
- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON **Adams, Mass.**

PHOENIX DISC WATER METERS

FEATURING
SPIRAL GEARS
(A Phoenix Patent)

Have an Excellent Record of Dependable — Accurate Service *Since 1914.*
Repair Parts for Water Meters
We furnish Parts for
UNION KING METERS
Send inquiries for prices.

PHOENIX METER CORP.
PRINCE BAY, S. I. NEW YORK, N. Y.

ANTHRAFILT
A Filter Medium For All Purposes
ANTHRACITE EQUIPMENT CORP.
19 Rector St. New York
H. G. Turner Research Engineer
STATE COLLEGE, PA.

WANTED

Commission salesman to sell an article to the water works trade. Liberal commission. No investment. Give full particulars, age, territory covered, number of bona fide customers, lines now handled. Box 95, Water Works & Sewerage, 330 So. Wells St., Chicago, Ill.

Executive Engineer, thoroughly familiar with water works construction, maintenance, operation, transmission and distribution system design, flow studies, waste surveys, meter maintenance program design, office routine and public relations. Nineteen year record of economic operation of large system. Position of Superintendent or Engineer desired. Address "A.D.T.", % Water Works & Sewerage, 155 East 44th Street, New York, N. Y.

PLAN NOW

To Attend the Second Annual Convention of the

Federation of Sewage Works Associations

at the Pennsylvania Hotel

New York City — October 9-11

The National Sewage Works Meeting of the Year

Engineers, Superintendents, Municipal Officials, Sewage Plant Operators, will profit by attending the year's most important meeting.

Addresses and discussion by recognized national speakers and sewage plant operators. Manufacturers' exhibits, inspection trips, as well as entertainment features, have been arranged to provide a most profitable meeting for those who attend—

PLAN NOW TO ATTEND!

WATER WORKS AND SEWERAGE

Consulting Engineers

Specializing in the field of

WATER WORKS & SEWERAGE

Albright & Friel, Inc.

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Water, Sewerage, Industrial Waste, Garbage, Power Plant and Valuation Problems.

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(Formerly Nicholas S. Hill Associates)

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Engineering Co.
McDONNELL-SMITH-BALDWIN-TIMANUS-McDONNELL

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Waterworks, Light and Power, Sewerage, Reports, Designs, Appraisals, Rate Investigations

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Water Supply and Purification, Sewerage and Sewage Treatment, Power Development and Applications

Investigations, Appraisals, Rates, Testimony, Design, Supervision, Operation, Accounting

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Investigations, Reports, Valuations, Design and Construction—Water Supply and Purification Plants, Sewerage and Sewage Treatment Works; Municipal Paving and Power Developments.

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St. Louis, Mo.

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WATER SUPPLY AND PURIFICATION
SEWAGE AND SEWAGE TREATMENT

Specializing in Water Quality Problems

Telephone 3-2939 **22nd and Market Sts. Harrisburg, Pa.**

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Paul E. Langdon — **Kenneth V. Hill**
Thomas M. Niles — **Samuel M. Clarke**

Water Supply, Water Purification, Sewerage, Sewage Treatment, Flood Control, Drainage, Refuse Disposal

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Havens and Emerson

(formerly Gascoigne & Associates)

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A. A. Burger — **F. C. Tolles** — **F. W. Jones**

Consulting Engineers

Water, Sewage, Garbage, Industrial Wastes, Valuations. — Laboratories

Leader Building, Cleveland **Woolworth Bldg., New York**

Morris Knowles, Inc.

Engineers

Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning.

1312 Park Building, Pittsburgh, Pa.

Charles J. Kupper

WATER WORKS—SEWERAGE

Water Purification and Sewage Treatment
Garbage and Rubbish Incineration
Industrial Wastes Treatment
Valuations

Telephone Dunellen 2-5700 **15 Stelton Road New Market, N. J.**

Lancaster Research Laboratories

Physical and chemical tests of Sewages, Sludges and Industrial Wastes.
Examinations, tests and reports on treatment processes and equipment. Experts in litigation.
Treatment processes for Industrial Wastes.

85 Zabriskie Street
Hackensack, New Jersey
Hackensack 3-2325

Metcalf & Eddy

Engineers

Water, Sewage, Drainage, Garbage and Industrial Wastes Problems
Laboratories — Valuations

Statler Building, Boston **150 Broadway, New York**

Reeves Newsom — E. H. Aldrich

Newsom & Aldrich

Engineer-Consultants

Water Supply, Purification and Distribution
Sewerage and Sewage Disposal
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Nussbaumer & Clarke, Inc.

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Municipal and Industrial Water Purification, Sewage Treatment, Operating Supervision of Plants, Sanitary Surveys, Stream Pollution Investigation, Swimming Pool Control. Chemical and Bacteriological Analyses, Testing of Materials.

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(Tel. Melrose 5-6579)

Stanley Engineering Company

Water Works — Sewerage
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Reports — Design
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Harry W. Clark, Associate
(Engineers (Est. 1869—Inc. 1924)
Channing Howard — Paul F. Howard
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Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.

89 Broad St., Boston, Mass.

Runyon & Carey
Consulting Engineers

Water Supply and Treatment, Sewerage and Treatment, Power Plants, Heating and Ventilation, Electric Lighting.

33 Fulton St., Newark, N. J.

Water Leak Detector Co.
Engineers

Pipe Line Location Maps
Water Leak Detector Instruments
Pipe Locators

166 N. Third St. — Columbus, Ohio

Whitman, Requardt & Smith
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Water Works—Sewerage—Utilities
1304 St. Paul Street, Baltimore, Md.
Albany, N. Y.

Save Money

WITH

ferri-floc
FERRIC SULPHATE

A Coagulant for all types of Water Treatment. Also adaptable for Waste Water Treatment. You can save by conditioning sludge with ferri-floc. Atlanta's Clayton plant uses ferri-floc alone. (No lime required to condition this sludge.) Send for free literature and sample to test in your plant.

Tennessee Corporation
ATLANTA, GA. — LOCKLAND, OHIO

The Largest Digester Installation is a P. F. T.

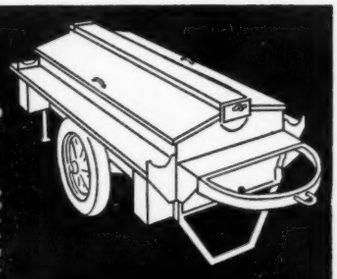
It's at Cleveland, Ohio, and it's P.F.T. Equipment, of course. Twelve 95' diameter hexagonal covers serve Cleveland's Easterly Plant (six others serve the Westerly Plant). It is one of many installations shown in Bulletin No. 132.

How sewage gas is utilized to heat water for the digester tank coils, thus hastening the digestion processes, and other design and operating features are detailed.

May we send a copy?

P.F.T. PACIFIC FLUSH-TANK COMPANY
4241 Ravenswood Ave., Chicago
New York — Charlotte, N. C.

Portable
TOOL BOXES
ALL STEEL



Littleford high speed trailing, all steel tool boxes are made to fit every job. Sturdy in construction, thief-proof and weather-proof. Will last a lifetime. Write for further information, today.

LB — BLACK TOP ROAD MAINTENANCE EQUIPMENT — SINCE · 1900
LITTLEFORD
Littleford Bros.
422 E. Pearl St.
Cincinnati, Ohio

INQUIRIES INVITED
on all Problems of
WATER TREATMENT

Whether your problem of water rectification is large or small, we have a form of equipment to serve your needs. We manufacture and install equipment for Gravity Filtration and Softening Plants; Pressure Filters and Zeolite Softeners; Swimming Pool Recirculating Appliances; and Water Treatment Units of all types.

ROBERTS FILTER MFG. CO.
607 COLUMBIA AVE.
DARBY, PA.

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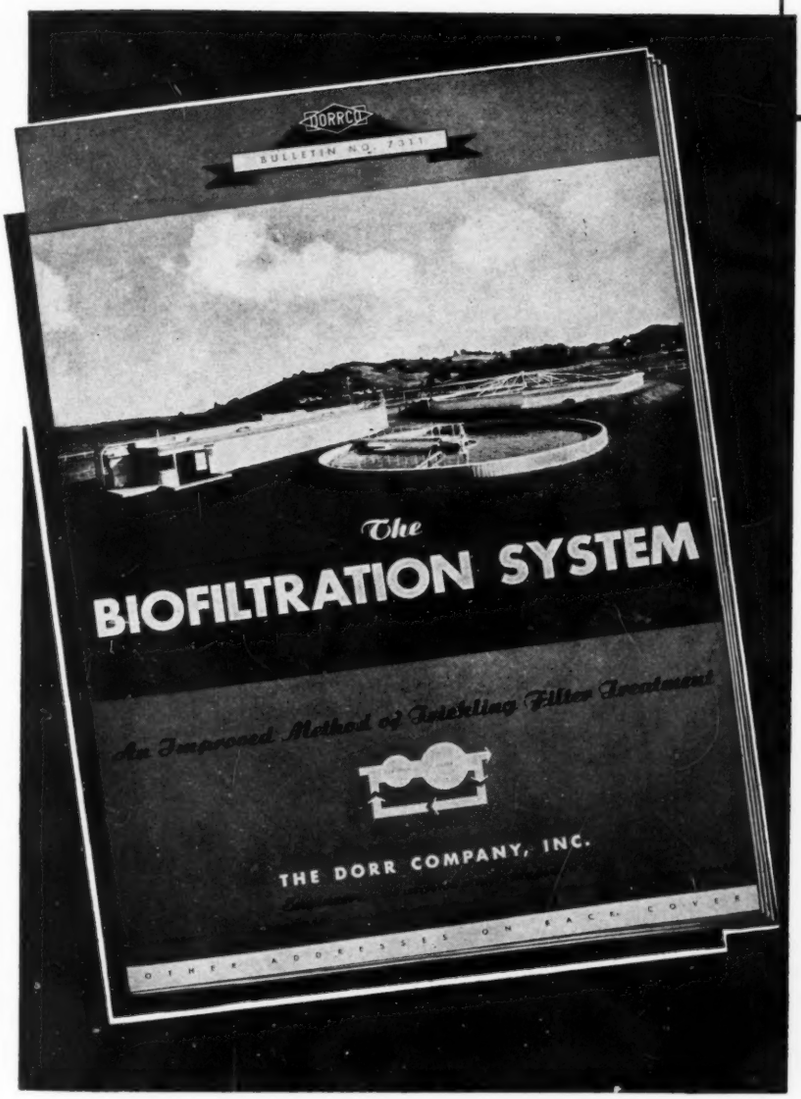

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